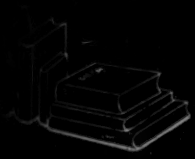
ABSTRACTS OF NORTH AMERICAN GEOLOGY



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ABSTRACTS OF NORTH AMERICAN GEOLOGY

INTRODUCTION

Abstracts of North American Geology contains abstracts of technical papers and books and also citations of maps on the geology of North America including Greenland, the West Indies, as well as the State of Hawaii, Guam, and other island possessions of the United States. Articles of a general nature by North American authors are cited even though published in foreign journals, but those by foreign authors are included only if they appear in North American journals. Abstracts are prepared only of material that is believed to be generally available. Ordinarily abstracts are not published of material with small circulation (such as dissertations, open-file reports or memorandums) or of other papers presented orally at meetings.

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The abstracts in this issue were prepared by Georgianna D. Conant, Howard R. Cramer, Raymond C. Douglass, Richard P. Fischer, Fred S. Fisher, Katherine A. Friberg, Richard E. Grant, Andrew Griscom, Boyd R. Haley, Glen A. Izett, Virginia M. Jussen, B. H. Kent, Elisabeth S. Loud, D. R. Mabey, Harold E. Malde, Mildred C. Mead, Willis H. Nelson, Virginia S. Neuschel, John Pojeta, Jr., M. W. Reynolds, Marie Siegrist, Vernon E. Swanson, Martha S. Toulmin, Dorothy B. Vitaliano, and Ray E. Wilcox.

ABSTRACTS

Aarstad, John. *See* Smith, Henry W. 05622

05453 **Adams, R. D.** Early reflections of P'P' as an indication of upper mantle structure: Seismol. Soc. America Bull., v. 58, no. 6, p. 1933–1947, illus., tables, 1968.

In many instances energy is observed preceding P'P' that can be interpreted only as reflections from discontinuities or inhomogeneities in the upper mantle. Early reflectons show a degree of consistency for a number of earthquakes, but there is less consistency from region to region. In most areas there is evidence for reflections from a depth of 65 to 70 km that could correspond to the top of the low-velocity channel. There is also fair evidence for reflecting surfaces at 110–140 km under Siberia and at 150–190 km under western Europe. Antarctica alone showed no reflections from depths greater than the M-discontinuity, which may indicate a more uniform mantle structure under Antarctica. The observations are consistent with what would be expected from inhomogeneities postulated in recent mantle models.—*from* Author's abstract

05177 **Adolphson, D. G.; LeRoux, E. F.** Temperature variations of deep flowing wells in South Dakota, *in* Geological Survey research 1968, Chap. D: U.S. Geol. Survey Prof. Paper 600-D, p. D60–D62, illus., table, 1968.

Measurements from about 200 deep artesian wells in South Dakota indicate that temperature differences in water flowing from wells of similar construction are related to the depth of wells and volume of discharge. Geothermal gradients at wells in the Dakota Sandstone east of the Missouri River range from 0.7°C per 100 feet in the southeast and 1.1°C per 100 feet in the northeast to 1.6°C per 100 feet along the Missouri River. Immediately west of the river, geothermal gradients average 1.5°C per 100 feet. In a "hot water belt" farther west, average geothermal gradients of 2.2°C per 100 feet may be due to deep high-temperature recharge to the Dakota Sandstone. Relatively low geothermal gradients in pre-Cretaceous rocks in the Black Hills may be due, in part, to rapid downward movement of recharging water in very porous formations.—Authors' abstract

05217 **Agterberg, F. P.** Further comments on the "Application of trend analysis in the evaluation of the Whalesback mine, Newfoundland" [1968], *in* Ore reserve estimation and grade control—Canadian Centennial Conf., Quebec, 1967: Canadian Inst. Mining and Metallurgy Spec. Vol. 9, p. 95–96, illus., table, 1968.

In Agterberg's reply to discussion by M. J. Piloski (ibid., p. 89–94), he compares and elaborates on trend analysis and the conventional area-of-influence method. A possible reason for Piloski's observation that at the footwall the one percent trend contour may extend into low-grade or barren material is discussed and alternative approaches are suggested.—ESL

05228 **Agterberg, F. P.** Application of trend analysis in the evaluation of the Whalesback mine, Newfoundland, *in* Ore reserve estimation and grade control Canadian Centennial Conf., Quebec, 1967: Canadian Inst. Mining and Metallurgy Spec. Vol. 9, p. 77–88, illus., tables, 1968.

A multiplicative model is discussed for approximation of the spatial variation of copper in the Whalesback ore deposit near Springdale, Newfoundland. Each

observed assay value X consists of three components: $X = e^{P}.S.N$, where P is a three-dimensional polynomial function, S (signal) represents small-scale gradational fluctuations in copper concentration and N (noise) represents random variations or sampling errors. The trends (systematic patterns of three-dimensional variation) satisfy: $E(X) = \exp(P + 1/s^2)$, where s^2 is the sum of logarithmic variances for signal and noise. Properties of S and N are determined by application of serial correlation techniques and spectral analysis to series of concentration values. The trends, E(X), are determined for blocks of rock that contain several hundreds of sampling points.—*from* Author's abstract

05584 **Ahmeduddin, Mir.** Subsurface geology of Wheatland area, Cleveland, McClain, Grady, Canadian, and Oklahoma Counties, Oklahoma: Shale Shaker, v. 19, no. 1, p. 2–19, illus., 1968.

Petroleum producing fields are reviewed briefly. Pennsylvanian uplift of the Oklahoma City area caused erosion of beds down to the Arbuckle Limestone across the uplift and to the Mayes Limestone south and west of the area. With earlier truncation of the top of the Hunton Limestone, secondary porosity developed. Major faults trending east of north brought Ordovician reservoir beds against Pennsylvanian source beds, which vary from structural traps to stratigraphic truncation and facies changes. Alternating transgressive and recessive units of the Cherokee Group, peripheral to the uplift, reflect radial drainage on the pre-Desmoinesian erosional surface; these onlapping sand bodies, previously miscorrelated, appear to be cyclic deposits correlative with Bartlesville, Red Fork, and Skinner sand zones and offer promise to future exploration.—GDC

00021 **Aki, Keiiti.** Analysis of the seismic coda of local earthquakes as scattered waves: Jour. Geophys. Research, v. 74, no. 2, p. 615–631, illus., tables, 1969.

A method was devised to extract useful information about the earthquake source from the coda of local small earthquakes. The method is based on the assumption that the power spectrum of coda waves of a local earthquake is only a function of time measured from the earthquake origin time and independent of distance and details of wave path to the station. Evidence supporting this assumption is presented, using the data on aftershocks of the Parkfield earthquakes of June 28, 1966. A simple statistical model of the wave medium that accounts for the observations on the coda is proposed. By applying the method to many Parkfield aftershocks, the relation between the seismic moment M_o and local magnitude M_L is determined as $\log M_o$ (dyne cm) $= 15.8 + 1.5\ M_L$. The size of a microearthquake with magnitude zero is estimated as 10×10 meters.—Author's abstract

Akin, P. D. *See* Reynolds, S. E. 05592

Alexander, S. S. *See* Glover, Peter. 00042

05609 **Alford, Donald; Clark, Robert.** The 1967 mass balance of Grasshopper Glacier, Montana: Northwest Sci., v. 42, no. 3, p. 115–123, illus., tables, 1968.

Grasshopper Glacier, a temperate alpine glacier lying in a north-facing cirque in the Beartooth Mountains of southwestern Montana, was studied during the summer of 1967 to determine its net mass balance. Based on measurements of accumulation and ablation, it is believed that the 1967 mass balance was positive, with a value of about 33×10^4 m^3. Specific net balance was $+0.81$ m/m^2. Because this was the first year of study, the authors emphasize that results are tentative.—MST

05612 **Ali, Syed A.** Acetate peels for the study of carbonate rocks: Pakistan Jour. Sci. and Indus. Research, v. 11, no. 2, p. 213–214, illus., 1968.

The use of commercial acetate film instead of cellulose nitrate solution has provided a more rapid method of preparing peels with an excellent textural image, and practically free of shrinkage and curling. A flat surface should be cut on the specimen, then ground and polished, and the polished surface etched for a few seconds. The etched surface is flooded with acetone and the film applied. Staining and mounting techniques are suggested. The peels can be used to evaluate texture, fabric, structure, and mineralogy.—ESL

05426 **Allen, J. H.** Long-term stability of self-oscillating rubidium magnetometers: Jour. Geomagnetism and Geoelectricity, v. 20, no. 3, p. 197–204, illus., table, 1968.

The development of automatic magnetic observatories that require digital recording of analog frequencies for direct transfer to computers and the increase in basic research into long-period field variations have accentuated the need for long-term stability in a magnetometer. Results are reported here of simultaneous magnetic total field measurements over a span of 17 months with a proton magnetometer and with a series of self-oscillating single-cell rubidium magnetometers. A comparison indicates variation in frequency response of the rubidium magnetometers to a fixed absolute magnetic field of as much as 7 gammas between different sensors, of 6 gammas when a sensor is returned, and time-variable over a 2 gamma range for an undisturbed sensor.—VSN

Allison, Stephen V. *See* Kaser, Rolland F. 05536

Alminas, Henry V. *See* Griffitts, Wallace R. 05425

Alsop, L. E. *See* Chandler, Ramesh. 05457

05380 **Anderson, Charles A.** Arizona and adjacent New Mexico, *in* Ore deposits of the United States, 1933–1967 (Graton-Sales Volume), V. 2: New York, Am. Inst. Mining, Metall. and Petroleum Engineers, p. 1163–1190, illus., table, 1968.

Most of the important ore deposits in these states are of Mesozoic and Tertiary age, dominated by the porphyry copper deposits spatially related to stocks, plugs, sills, or dikes of quartz-bearing porphyritic to granular rocks. Intense hydrothermal alteration accompanied the metallization of all of the copper deposits. Host rocks are the intrusives, Precambrian schist and granites, Paleozoic limestone, Mesozoic porphyritic andesite, and Mesozoic arkose and siltstone. Breccia pipes, veins, and limestone replacements account for some important deposits of Mesozoic and Tertiary age. The St. Anthony copper deposit in Arizona, of Cenozoic age, is unique, consisting of a lead-zinc vein associated with later molybdenum and vanadium oxide deposits. Cenozoic manganese also occurs in western Arizona and may become important.—*from* Author's abstract

05411 **Anderson, Gerald J.** The Marquette district, Michigan, *in* Ore deposits of the United States, 1933–1967 (Graton-Sales Volume), V. 1: New York, Am. Inst. Mining, Metall. and Petroleum Engineers, p. 507–517, illus., tables, 1968.

The Precambrian rocks of the Marquette Range have been correlated with the Animikie Series of the Thunder Bay district, Ontario, and are contained in a westward plunging synclinorium that is about 33 miles long and 3 to 6 miles wide. The Negaunee Iron-Formation reaches a thickness of 2,500 feet. The primary iron content is 26 percent and the altered ore is 31 percent. The ores produced to date fall into four categories: high-grade soft ores, high-grade hard ores, siliceous ores, and concentrates and agglomerates (pellets). The soft ores generally are found in synclines and in fault-trough structures, bounded by mafic dikes along at least one side, and are found mainly in the basal portion of the Negaunee; the hard ore occurs in the upper part.—*from* Author's abstract

05331 **Anderson, Gordon D.** The equation of state of ice and composite frozen soil material: U.S. Army Materiel Command Cold Regions Research and Eng. Lab. Research Rept. 257, 50 p., illus., tables, 1968.

Shock wave techniques provide a powerful tool for investigating equations of state at very high stress levels. The stress-volume behavior of frozen soil-water mixtures in the range from 60 to 500 kbar was investigated. Hugoniot data were obtained for Ottawa banding sand (pure quartz) and West Lebanon, N.H., glacial till of varying degrees of saturation and for polycrystalline and monocrystalline ice (c-axis in direction of shock propagation). Release cross-curve data were obtained for dry and saturated Ottawa sand and for polycrystalline ice. All materials were at an initial temperature of -10°C; plane one-dimensional shock waves were used. Curves for the soil materials show evidence of a quartz-stishovite phase transition

at about 300 kbar. The Hugoniots of single and polycrystalline ice do not differ significantly over the stress range studied.—*from* Author's abstract

05623 **Anderson, Henry R.** Geology and ground-water resources of the Rahway area, New Jersey: New Jersey Div. Water Policy and Supply Spec. Rept. 27, 72 p., illus., tables, geol. map, 1968.

The Rahway area is underlain by Triassic Brunswick Shale which contains sandstone beds and is more than 6,000 feet thick. The Cretaceous Raritan Formation, overlying the Brunswick unconformably to the southeast, is a series of clays and sands of about 100 feet thick in the outcrop area. Wisconsin glacial drift, from several feet thick on hilltops to 100 feet in terminal moraine, blankets both formations. About 6 mgd is pumped from the Brunswick, where both water-table and artesian conditions exist; water is locally high in sulfate, dissolved solids, and hardness. About 1 mgd is pumped from the Farrington Sand Member of the Raritan, hydraulically separated from the Brunswick by basal Raritan fire-clay; salt water is encountered in wells in one area. More than 1 mgd is pumped from wells tapping drift underlying the city of Rahway and underlying Brunswick Shale; average yield is 370 gpm.—*from* Author's abstract

Anderson, Roy A. *See* McConnel, Roger H. 05354

05291 **Anderson, Thomas F.** Surface area measurement in calcite grains by isotopic exchange with C-14—labeled dioxide: Geochim. et Cosmochim. Acta, v. 32, no. 11, p. 1177-1186, illus., table, 1968.

A method is presented for measuring the surface area of calcite grains by isotopic exchange with C-14—labeled CO_2. Tracer uptake is monitored by back exchange of the surface activity into C-14—free CO_2. C-14 activity is measured by direct liquid scintillation counting of 10 m-mole quantities of CO_2 dissolved in toluene under pressure. At 200°-300°C reversible exchange of annealed calcite samples yields surface aras in good agreement with values determined by grain-size measurements. Exchange surface areas of unannealed grains are threefold higher than these "geometric" values. A measurable fraction of total exchange activity can only be recovered by dissolving the sample. The exchange reaction obeys a logarithmic rate law at 75° and 125° C. This suggests that the exchange mechanism involves the chemisorption of CO_2 on a calcite surface of heterogeneous reactivity.—*from* Author's abstract

05555 **Andrews, James Crandall.** A Guatemala volcano twenty years after: Appalachia, mag. no. 147, p. 212-222, llus., 1968.

This description compares the present activity and appearance of volcanoes in the Guatemala City area, particularly the 'baby' Pacaya, with a 1945 account. Varying accounts of eruptions of Pacaya since 1565 mention violent activity, but H. Tazieff (1952) lists this volcano as extinct. It was far from dead in 1944, as indicated by fumaroles, but until 1961 was fairly quiet. In 1965 and 1966 it was possible to enter the old crater and watch eruptions in a new one within it; vibrations experienced and material ejected are described. By 1968, the crater was considerably more filled with lava and a ridge where horses had grazed in 1965 was jet black with lava. With frequent eruptions, loose lava has poured down the cone and cliffs of the old crater have collapsed; a thermometer inserted 6 inches into the crater floor registered 110°C.—GDC

05490 **Armstead, H. C. H.** Fresh water from geothermal fluids [with French and Spanish abs.], *in* Water for peace—Internat. Conf., Washington, D.C., 1967—V. 3, Water supply technology: Washington, D.C., U.S. Govt. Printing Office, p.106-116, illus., 1968.

In recent years there has been a remarkable increase of interest in the development of geothermal energy for production of power, and also as natural heat for domestic or industrial purposes. A further possible use for geothermal fluids is for production of fresh water, particularly in arid areas where it would be of great social and economic importance. Although the fluids are invariably contaminated, they could serve as a source of water by using steam for purified water by condensation or

by using the water contaminated with dissolved salts as raw water to a desalination plant. It is necessary to compromise quantitatively between power and water as the desired products. Mixed geothermal fields can be analysed into their components in four categories.—MCM

Aslam, M. *See* Coates, D. F. 05725

Auld, D. R. *See* Caner, B. 05472

05607 **Avery, George S.** Edmund Ware Sinnott (February 5, 1888–January 6, 1968): Torrey Bot. Club Bull., v. 95, no. 6, p. 662–674, portrait, 1968.

Babad, Harry. *See* Goldberg, Marvin C. 05173

05470 **Bachman, George O.** Geology of the Mockingbird Gap quadrangle, Lincoln and Socorro Counties, New Mexico: U.S. Geol. Survey Prof. Paper 594–J, p. J1–J43, illus., table, geol. map, 1968.

Bedrock formations exposed include Precambrian granite, Paleozoic sedimentary rocks, and igneous dikes and sills of probable Tertiary age. In ascending order early Paleozoic rocks are Bliss Sandstone (Late Cambrian–Early Ordovician), El Paso Dolomite (Early Ordovician), and Upham Member of the Montoya Dolomite (Middle Ordovician) disconformably overlying the El Paso. No Silurian, Devonian, and Mississippian rocks are exposed. Pennsylvanian clastics and carbonates lap across earlier sediments. Permian rocks, a series of interbedded marine limestones, redbeds, and clastics, are the Bursum, Abo, and Yeso Formations. Northward wedging out of the pre–Pennsylvanian strata is attributed to epeirogenic movement along an east–west hinge line. Tertiary tectonic activity occurred in two stages, the latter of which caused the present–day block–faulted mountains.—*from* Author's abstract

Bagan, Richard J. *See* Gray, Raymond F. 05359

00001 **Bailey, R. V.** Applied geology in Shirley basin uranium district, *reprinted in* Report on Wyoming Governor's Conf. on Uranium, Casper, Wyo., 1968: Mines Mag., v. 59, no. 1, p. 12, 14–16, 1969; originally published 1965.

The Shirley basin uranium deposits occur in poorly consolidated sandstone beds of Tertiary age. They are narrow, elongate bodies that were localized along a geochemical front or interface between large tongues of altered (oxidized) sandstone and unaltered (unoxidized) sandstone. Presumably the mineralizing solutions were oxygenated ground water that moved downdip along the bed of host sandstone to a reducing environment where the uranium precipitated. The observed relations were applied successfully in guiding exploration.—RPF

Baird, Donald. *See* Carroll, Robert L. 05715

05348 **Baker, Arthur, 3d.; Clayton, Robert L.** Massive sulfide deposits of the Bagdad district, Yavapai County, Arizona, *in* Ore deposits of the United States, 1933–1967 (Graton–Sales Volume), V. 2: New York, Am. Inst. Mining, Metall. and Petroleum Engineers, p. 1311–1327, illus., table, 1968.

Two massive sulfide zinc–copper bodies are in quartz–sericite schist (probably formed by regional metamorphism of sediments) and andesite of the Precambrian Yavapai Series on opposite sides of a large rhyolite mass. The Copper Queen body is conformable with the bedding of its schist host rock, but the Old Dick body crosscuts the strata. The orebodies are almost entirely enclosed by premineral faults. Pyrite, chalcopyrite, and sphalerite are the chief minerals. Andesite and quartz–sericite schists, for at least several hundred feet around both orebodies, have been chloritized erratically and contain traces of copper.—*from* Authors' abstract

05178 **Baker, C. H., Jr.** Thermal springs near Midway, Utah, *in* Geological Survey research 1968, Chap. D: U.S. Geol. Survey Prof. Paper 600–D, p. D63–D70, illus., table, 1968.

A group of thermal springs near Midway, Utah, is surrounded by a deposit of calcareous tufa that covers an area of about 4.5 sq mi and locally is at least 70 feet thick. The springs include both flowing thermal springs and hot pots, which are small pools of warm water occupying shallow craters in the tops of conical or hemispherical mounds of tufa. Extinct hot pots (dry craters) and solid mounds of tufa as much as 10 feet high are also common. Water from the flowing springs and hot pots is not highly mineralized (the total dissolved solids rarely exceeds 2,000 mg/l), but it is saturated with respect to calcium carbonate. Spring water, of meteoric origin, enters the carbonate bedrock in the nearby Wasatch Range and moves rapidly through fractures and solution openings. The geothermal gradient in the vicinity of Midway is abnormally high, bul reasons for the high heat flux are not known.—*from* Author's abstract

Bamber, E. W. *See* Macqueen, R. W. 05524

05743 **Bamber, E. W.; Taylor, G. C.; Procter, R. M.** Carboniferous and Permian stratigraphy of northeastern British Columbia: Canada Geol. Survey Paper 68-15, 25 p., illus., tables, 1968.

Upper Paleozoic rocks beneath plains and in outcrop belt of northeastern British Columbia are divisible into five gross units: shale of Besa River and Banff Formations (Devonian–Mississippian), carbonate rocks of Prophet, Pekisko, Shunda, and Debolt Formations (Mississippian), sandstones and shales of Stoddart and Mattson Formations (Mississippian and Pennsylvanian), mostly siltstone of Kindle and lower Belloy Formations, and chert of Fantasque and upper Belloy Formations (latter all Permian). Eastern Mississippian carbonate units pass westward into the Besa River shales. The Stoddart is the fine-grained equivalent of the Mattson sandstone; both change laterally westward into the Besa River. Unconformities separate the Kindle and Belloy Formations from the Stoddart, Prophet, and Debolt, and the Fantasque from the Kindle.—*from* Authors' abstract

05254 **Bardack, David; Zangerl, Rainer.** First fossil lamprey—A record from the Pennsylvanian of Illinois: Science, v. 162, no. 3859, p. 1265–1267, illus., table, 1968.

A fossil record of lampreys has previously been unknown. A new genus demonstrates the presence of this group in the Pennsylvanian. The body outline, parts of the head skeleton, rasping tongue mechanism, gill basket, and other internal organs are preserved. The fossils are very similar in structure to modern forms. The absence of hagfish characters in the fossil supports the view that the common ancestor of lampreys and hagfishes lived prior to the Pennsylvanian.—Authors' abstract

05697 **Bardack, David.** *Belonostomus* sp, the first holostean from the Austin Chalk (Cretaceous) of Texas: Jour. Paleontology, v. 42, no. 5, p. 1307–1309, illus., 1968.

Two specimens [lower and upper jaw and presymphysial bone] referable to the aspidorhynchid holostean *Belgnostomus* [from the Ector Chalk Formation in north-central Texas] are similar to *B. cinctus* (Woodward) from approximately contemporaneous [Coniacian] beds of the English Chalk.—Author's abstract

Barnes, F. Q. *See* Stockwell, C. H. 05653

Barnes, F. Q. *See* Stockwell, C. H. 05654

05376 **Barnes, Marvin P.; Simos, John G.** Ore deposits of the Park City district with a contribution on the Mayflower lode, *in* Ore deposits of the United States, 1933-1967 (Graton-Sales Volume), V. 2: New York, Am. Inst. Mining, Metall. and Petroleum Engineers, p. 1102–1126, illus., tables, 1968.

Carboniferous to Triassic rocks were folded, thrust faulted, and intruded by Laramide diorite and diorite porphyry, then normal faulted during the Laramide orogeny. The orebodies are widely scattered lode and bedded replacement deposits. Large bedded replacement silver–lead–zinc deposits associated with east–west zones of fissuring have been mined from the Park City Formation. Ore is currently being mined from strong bedded replacement bodies in the Humbug Formation. Factors

controlling ore deposition are: magmatic source, structural feeder systems, and favorable host rocks. Ore deposition along favorable beds is primarily a function of physical conditioning and secondarily of chemical composition.—*from* Authors' abstract

Barnes, Robert H. *See* Wilson, Charles W., Jr. 05541

Barnes, Robert H. *See* Wilson, Charles W., Jr. 05544

05289 **Bauer, A.; Baussart, M.; Carbonnell, M.; Kasser, P.; Perroud, P.; Renaud, A.** Missions aériennes de reconnaissance au Groenland, 1957–58—Observations aériennes et terrestres, exploitation des photographies aériennes, determination des vitesses des glaciers vêlant dans Disko Bugt et Umanak Fjord [with English abs.]: Medd. Grönland, v. 173, no. 3, 116 p., illus., tables, 1968.

From airphotos and direct observations, it has been possible to map crevassed areas on the west side of the ice sheet, to delimit catchment basins of large glaciers between 68° and 72° N., and to determine annual velocity of the ice sheet by photointerpretation of intervals between large crevasses. Operations in 1958 included setting up ablation stakes and coring tests for tritium dating. A technique for measuring mean velocity at glacier fronts by taking repeated airphotos proved successful. Frontal velocities of 20 glaciers vary between 0.9 and 13.1 m/24 h. Solid discharge of all outflow glaciers is estimated at 90±10 percent km^3/yr of ice. This is larger than previous estimates and strengthens the conclusion that the mass balance of the whole ice sheet is negative. Transverse profiles of velocity show an acceleration towards the glacier front where it reaches its maximum.—*from* Author's abstract

05306 **Bauer, A.** Exploitation des couvertures photographiques aériennes répétées du front des glaciers vêlant dans Disko Bugt et Umanak Fjord, Juin–Juillet 1964—[Pt.] 2, Accélération de l'–ecoulement des glaciers groenlandais vers leur front et détermination de leur débit solide [with English abs.]: Medd. Grönland, v. 173, no. 5, p. 55–78, illus., tables, 1968.

Glaciers show an acceleration of flow toward their fronts; not all have a floating front. For those with high velocity, great differences exist between 1957 and 1964 measurements. Mean velocity at the front multiplied by mean thickness gives the solid discharge which, for the 20 glaciers studied, reaches about 100 km^3/yr ± 3 percent. Jakobshavns Isbrae, the most active, has a solid discharge of 36.6 km^3/yr, which means 1045 m^3/sec of water. Total discharge of outflow glaciers from the icecap is calculated to be 280 km^3/yr of water. Negative balance of the icecap reaches –110 km^3/yr of water, which means a water layer of 0.3 mm/yr spread out over all the seas.—*from* Author's abstract

Baussart, M. *See* Bauer, A. 05289

05399 **Bayley, Richard W.** Ore deposits of the Atlantic City district, Fremont County, Wyoming, *in* Ore deposits of the United States, 1933–1967 (Graton–Sales Volume), V. 1: New York, Am. Inst. Mining, Metall. and Petroleum Engineers, p. 589–604, illus., tables, 1968.

The Atlantic City district is in folded and faulted Precambrian metamorphic rocks near the south end of the Wind River Range. Sedimentary iron formation, similar to the Lake Superior taconite, occurs in the northern part of the district. Locally, where the iron formation is thickened by folds and faults, sufficient tonnages are present to be minable. Indicated reserves of iron–formation (about 30 percent iron) are reported to be about 300 million tons.—*from* Author's abstract

05452 **Ben–Menahem, Ari; Jarosch, H.; Rosenman, M.** Large scale processing of seismic data in search of regional and global stress patterns: Seismol. Soc. America Bull., v. 58, no. 6, p. 1899–1932, illus., tables, 1968.

A composite computer program has been devised for fast reduction of multistation seismic data in the period range 50–500 sec for mantle surface waves and 20–100 sec for body waves. The analysis reconstructs the seismic source from the spectrum

of its far radiation field and the correlation of its parameters with its depth, size, and regional environment. Two examples illustrate the capability of the computational procedure. Other applications of the proposed data processing are foreseen—a tsunami warning system and focal depth determination from spectral modal ratios. A persistent search for stress patterns, based on the processing of a sufficiently large sample of seismic events, is essential to any future program of earthquake prediction.—DBV

05588 **Bennett, N. B., Jr.** The importance of complete and reliable basic data in planning and designing for water resource development [with French and Spanish summ.], *in* Water for peace—Internat. Conf., Washington, D.C., 1967—V. 4, Water supply technology: Washington, D. C., U. S. Govt. Printing Office, p. 684–694, 1968.

The sufficiency of planning for any water development is primarily dependent upon adequacy of basic data, which will vary from place to place in nature, quality, and quantity. The best available information on the intimate geological characteristics of the area is a prime requisite for construction or ground-water exploration. Hydrologic data can be obtained only over extended periods of time. Essential basic data on topography include horizontal and vertical control and mapping at scales consistent with functional purposes. Land-resource data include basic knowledge and understanding of physical and chemical characteristics of soil, water, and near-surface geology and possible reactions and interactions among them. Engineering, human, and economic data are important also.—MCM

Bennett, R. H. *See* Keller, G. H. 05627

Berg, Joseph W., Jr. *See* Trembly, Lynn D. 05456

05720 **Berg, Robert R.** Point-bar origin of Fall River Sandstone reservoirs, northeastern Wyoming: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 11, pt. 1, p. 2116–2122, illus., table, 1968.

On the northeast flank of the Powder River basin the Lower Cretaceous Fall River Sandstone contains oil-bearing stratigraphic traps. The Fall River reservoir sandstone was believed to have been deposited as barrier bars with the updip permeability barriers provided by lagoonal shale. New investigations (Mettler, 1966) suggest origin as a point-bar sand in a meandering stream channel with permeability barrier provided by a clay-filled, abandoned channel. This interpretation is applicable to the West Moorcroft oil field and, as shown by the distribution of sandstone, to the Coyote Creek and Miller Creek fields. A pattern based on the thickness of the permeable sandstone is remarkably similar to that of the permeable sand in point-bar, swale, and channel deposits of recent stream-meander belts.—*from* Author's abstract

Beutner, Edward L. *See* Crump, Robert M. 05417

05512 **Bishop, Allen David, Jr.** The polymerization of silicic acid in dilute aqueous solutions [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 29, no. 5, p. 1621B, 1968.

05629 **Bissell, H. J.; Chilingar, G. V.** Shelf-to-basin Permian sediments of southern Nevada, U.S.A., *in* Internat. Geol. Cong., 23d, Prague, 1968, Proc., Sec. 8, Genesis and classification of sedimentary rocks: Prague, Academia, p. 155–167, illus., 1968.

Throughout Early to medial Permian the Las Vegas Line was a northeast-southwest trending tectonic hinge that marked the change from shelf facies on the east to basin facies on the west in southern Nevada. Marine and nonmarine successions of shelf environment facies gradually undergo changes in a westerly to northwesterly direction, and when the Las Vegas Line is crossed rapid facies changes occur and most of the sequence is marine. Medial to Early Late Permian was typified by carbonate-evaporite-carbonate sedimentation mostly in a stable to unstable shelf environment during transgressive-regressive-transgressive marine conditions. Finally, regressive conditions dominated. A substantial disconformity was formed, with the Moenkopi Formation laid down under nonmarine then marine environmental condilions.—*from* Authors' abstract

05487 **Bither, T. A.; Bouchard, R. J.; Cloud, W. H.; Donohue, P. C.; Siemons, W. J.** Transition metal pyrite dichalcogenides—High pressure synthesis and correlation of properties: Inorganic Chemistry, v. 7, no. 11, p. 2208–2220, illus., tables, 1968.

The pyrite-type dichalcogenides ZnS_2, $ZnSe_2$, CdS_2, and $CdSe_2$ have been synthesized at high pressure (65–89 kbars). Electrical, magnetic, and spectral data have been obtained on the pyrite series of compounds MX_2 (many in single crystal form) where M = Fe, Co, Ni,Cu,Zn and X = S,Se,Te(no $ZnTe_2$). These data have been used to develop a qualitative band model that allows a consistent interpretation of the diverse properties of the MeX_2 to ZnX_2 pyrite group of compounds. The importance of covalent interaction between the cation and the chalcogen is emphasized. This interaction leads to a broadening of the cation e_g levels into a band of collective antibonding electron states which can lead to metallic conductivity when partially filled. A new computer technique is described for evaluating the results of reflectance measurements made with polarized light.—Authors' abstract

05368 **Bjerrum, L.; Kenney, T. C.** Effect of structure on the shear behaviour of normally consolidated quick clays [with French résumé], *in* Geotechnical conference on shear strength properties of natural soils and rocks, Oslo, 1967, Proc., V. 2: Oslo, Norwegian Geotechnical Inst., p. 19–27, illus., 196.

Results of laboratory tests and studies of field evidence in recent years at the Norwegian Geotechnical Institute are summarized to form an up-to-date concept of the behavior of quick clays, with particular reference to effects of structural arrangement. When clay with an open structure is subjected to increasing shear strain, the stress-strain curve measures first the resistance of the structure to distortion, then gradual failures and sliding. The strength of the structure is considered to be strongly dependent on consolidation stresses during shear. The undrained shear strength depends entirely on structural strength; the drained case shows the same structural breakdown with shear strength dependent on frictional resistance. If drainage is slow in the field, a drained stress condition can suddenly become an undrained case leading to abrupt failure.—GDC

05513 **Blacet, Philip Merrell.** Precambrian geology of the SE 1/4 Mount Union quadrangle, Bradshaw Mountains, central Arizona [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 29, no. 5, p. 1726B–1727B, 1968.

05297 **Blackburn, W. H.** The spatial extent of chemical equilibrium in some high-grade metamorphic rocks from the Grenville of southeastern Ontario: Contr. Mineralogy and Petrology, v. 19, no. 1, p. 72–92, illus., tables, 1968.

Two samples of high-grade metamorphic gneisses from the Grenville Series of southeastern Ontario were selected for intensive study. The garnets of one specimen, possessing a biotite-garnet-cordierite assemblage, underwent *in situ* laser microprobe spectrochemical determinations for Fe, Mg, Mn, and Ca. Conclusions are thus possible as to the volumes over which free diffusion and chemical equilibrium took place. These volumes were found to be on the order of only a few cubic centimeters and their shapes are strongly controlled by rock structures such as foliation and lineation. A higher-grade pyroxene granulite was also investigated with respect to garnet and biotite equilibrium; somewhat larger volumes of equilibration were noted in this rock.—*from* Author's abstract

05211 **Blagbrough, John W.; Farkas, Steven E.** Rock glaciers in the San Mateo Mountains, south-central New Mexico: Am. Jour. Sci., v. 266, no. 9, p. 812–823, illus., 1968.

Two types of rock glaciers of Wisconsin age occur on the northern slopes of the highest peaks. Tongue-shaped rock glaciers, 300–800 feet long, occur in cirques. Lobate rock glaciers occur at the base of talus slopes on the valley sides, and are smaller. Both are characterized by well-defined longitudinal and transverse ridges. The rock glaciers have elevations of about 9,000 feet and are composed of angular and subangular blocks of rhyolite with average lengths of 3–4 feet. The debris is stabilized, and most surfaces are free of vegetation excapt for lichen. Regional studies show the rock glaciers to be nonglacial in origin; the rock masses are thought to have moved because of flow of interstitial ice. The tongue-shaped ones developed

from coalescing protalus lobes, whereas the lobate glaciers formed from individual protalus lobes.—*from* Authors' abstract

Blais, R. A. *See* David, M. 05222

05226 **Blais, Roger A.; Carlier, Pierre A.** Applications of geostatistics in ore evaluation, *in* Ore reserve estimation and grade control—Canadian Centennial Conf., Quebec, 1967: Canadian Inst. Mining and Metallurgy Spec. Vol. 9, p. 41–68, illus., 1968.

Geostatistics, the study of the spatial correlations between assay values, ore widths, or other geological phenomena showing intrinsic dispersion, is based on Matheron's theory of regionalized variables, and takes into account geometric relations between samples and their zone of influence; the variogram function is the basic tool. One of the most important steps is calculation of the extension geovariances, the error committed when extending grade of samples to their various zones of influence; examples are given and Kriging techniques discussed. Practical applications of geostatistics in ore evaluation include calculation of error of estimation of the average grade and tonnage. Using extension geovariances, it is possible to estimate effect of varying grade cut-offs and block size in selective mining. A few of the main mathematical concepts of Matheron's theory are given in an appendix.—*from* Authors' abstract

Blumer, John W. *See* Matson, Robert E. 05660

05458 **Bolt, B. A.; Lomnitz, Cinna; McEvilly, T. V.** Seismological evidence on the tectonics of central and northern California and the Mendocino escarpment: Seismol. Soc. America Bull., v. 58, no. 6, p. 1725–1767, illus., tables, 1968.

Of 300 regional earthquakes in 1962 through June 1965, the three greatest concentrations occur close to the north-facing Gorda escarpment off Cape Mendocino, in the Coast Ranges west of the San Andreas fault between Watsonville and Salinas, and in the Gabilan Range west of the San Andreas fault near the Pinnacles. Fault motions in these areas, determined from first motions of P, are discussed. Overall, from the Gulf of California to the Juan de Fuca ridge, seismicity and earthquake mechanism agree well with a mechanism model based on the transform fault theory of J. Tuzo Wilson (1965). Some motion is transferred by transcurrent faulting from the San Andreas fault across the Gorda basin to the Blanco transform-fault system.—DBV

05275 **Bolton, Thomas E.** Silurian faunal assemblages, Manitoulin Island, Ontario, *in* The geology of Manitoulin Island—Michigan Basin Geol. Soc., Ann. Field Excursion, 1968: [Lansing, Mich., Michigan Geol. Survey] p. 38–49, illus., 1968.

Each of the Silurian formations contains a distinct biotope. Certain forms are confined to specific horizons; a few forms in each biotope specifically and (or) generically have more than provincial correlative value. The formations, in ascending order, are the Manitoulin, Cabot Head, Dyer Bay, Wingfield, St. Edmund, Fossil Hill, Amabel, and Guelph. Transitional phases are evident between the St. Edmund–Fossil Hill and Fossil Hill–Amabel Formations, but complete contemporaneity of the Niagaran succession inherent in Shelden's [1963] hypothesis is not entirely proven. Biohermal and biostromal facies are discernable locally in the Manitoulin Formation and are widespread in the St. Edmund, Fossil Hill, and Amabel Formations. Others, previously thought to be fore-reef facies in the Amabel, are retained in the Fossil Hill Formation.—*from* Author's abstract

05754 **Bonner, John Tyler.** Size change in development and evolution, *in* Paleobiological aspects of growth and development, a symposium: Paleont. Soc. Mem. 2 (Jour. Paleontology, v. 42, no. 5, supp.), p. 1–15, illus., 1968.

Phylogeny is a succession of ontogenies, and the two have been compared in terms of rates of size change. In development, the larger the organism, the slower its rate of size increase. In evolution, the fast changes occur over short periods (1–10 thousand years) and are as likely to show size decrease as increase; the medium changes (5–20 million years) are predominantly size increase; the slow changes, over the entire span of organic evolution, represent maximum size attained in various

phyla. For ontogeny, a decrease in rate of size change is correlated with an increase in complexity, in number of gene actions. For evolution, it is correlated with an increase in the number of genetic changes required of the genome by natural selection in fluctuating environments.—*from* Author's abstract

05202 **Books, Kenneth G.** Magnetization of the lowermost Keweenawan lava flows in the Lake Superior area, *in* Geological Survey research 1968, Chap. D: U.S. Geol. Survey Prof. Paper 600–D, p. D248–D254, illus., table, 1968.

The average direction of remanent magnetization for the lowermost Keweenawan lava flows in the Lake Superior region is significantly different in direction and opposite in polarity from that of the middle Keweenawan Portage Lake Lava Series and the upper Keweenawan Copper Harbor Conglomerate. This same general direction and apparent reversal in the Earth's geomagnetic fields is present in other geologic units of Precambrian age around the periphery of Lake Superior, suggesting a similar time interval for all, and providing a datum that can be utilized in further paleomagnetic studies in the region.—Author's abstract

Bookstrom, Arthur A. *See* Wallace, Stewart R. 05400

05462 **Borcherdt, R. D.; Healy, J. H.** A method for estimating the uncertainty of seismic velocities measured by refraction techniques: Seismol. Soc. America Bull., v. 58, no. 6, p. 1769–1790, illus., tables, 1968.

Time residuals from 75-km segments of 18 crustal seismic-refraction profiles in the Basin and Range province are used to investigate the validity of the linear-regression model and to make large sample estimates of variance in traveltime distributions. A formula for unbiased estimates of velocity uncertainty is derived, assuming a linear trend with distance for the variances of the traveltime distributions. The chi-square test implied 84 percent of the time-residual samples were inconsistent with the hypothesis that their parent populations had Gaussian distributions. A method is developed for estimating uncertainties in velocities which requires large sample estimates of traveltime variances, information on the quality of data, location of recording interval, and number of recording units.—*from* Authors' abstract

Borcsik, M. *See* Gammon, J. B. 00034

05771 **Bork, Kennard B.; Perry, T. G.** Bryozoa (Ectoprocta) of Champlainian age (Middle Ordovician) from northwestern Illinois and adjacent parts of Iowa and Wisconsin—Pt. 3, *Homotrypa, Orbignyella, Prasopora, Monticulipora,* and *Cyphotrypa*: Jour. Paleontology, v. 42, no. 4, p. 1042–1065, illus., tables, 1968.

Part 3 of this study is concerned with bryozoan species from four limestone units (Mifflin, Quimbys Mill, Guttenberg, and Ion Formations); these rock units of Champlainian age (Middle Ordovician) are exposed in northwestern Illinois and adjacent parts of Iowa and Wisconsin. Representatives of the following genera are discussed: *Homotrypa* Ulrich (including 6 species, 2 variants), *Orbignyella* Ulrich and Bassler (one species), *Prasopora* Nicholson and Etheridge (2 species), *Monticulipora* d'Orbigny and *Cyphotrypa* Ulrich and Bassler (one species each).—*from* Authors' abstract

05438 **Bostrom, R. C.; Vali, V.** A seismograph to observe deviatoric strains: Trend Eng., v. 20, no. 4, p. 7–12, 40, illus., 1968.

The design of a seismograph intended to observe shape changes in a ground sample is based upon the four-sided element devised by Kelvin to specify strain. The sensor is an interferometer having the form of a tetrahedron described by reflectors at its corners. The light source is a single laser. In respect to deviatoric strains, the response is linear and free of phase distortion from zero frequency (unrecovered deformation) to 300 Hertz. The lower limit of detection is that strain in excess of 5×10^{-6} cumulative in a time interval of arbitrary length is detectable without dependence upon laser frequency or intensity variations. In respect to waves, all six elements of the strain tensor are observed. This permits directional reception and mode separation such as the independent observation of shear and compressional waves.—RCB

Bouchard, R. J. *See* Bither, T. A. 05487

05707 **Boucot, A. J.; Johnson, J. G.** Evidence of color banding in a Lower Devonian rhynchonellid brachiopod: Jour. Paleontology, v. 42, no. 5, p. 1208–1209, illus., 1968.

A single specimen of Lower Devonian brachiopod from the Bathurst Island Group of Arctic Canada bears subradial dark brown bands preserved in the light colored shell material. The specimen is believed to be the brachial valve of a rhynchonellid indeterminate as to genus.—Authors' abstract

05300 **Bracey, Dewey R.** Structural implications of magnetic anomalies north of the Bahama–Antilles Islands: Geophysics, v. 33, no. 6, p. 950–961, illus., tables, 1968.

Seven individual shipboard and airborne magnetic surveys have been conducted north of the Bahama–Antilles Islands by the Naval Oceanographic Office since 1962. A computed main magnetic field model was used to reduce observed data from surveys to a common magnetic residual chart. Two anomaly trends, each composed of linear magnetic features, dominate the residual chart. One trend strikes northeast-southwest, the other at an angle of 80° to it. By relating the residual magnetic anomalies to structural features observed on an experimental model developed by Billings and to actual structural features in the northern Antilles, it is shown that the anomalies could be engendered by structural features resulting from an east-west horizontal couple. The line of action of this couple is consistent with prevalent theories on continental drift.—*from* Author's abstract

Bradbury, James C. *See* Grogan, Robert M. 05406

05747 **Brand, E. W.** Discussion—"Analyzing pumping tests by resistance network analogue," by R. Herbert, 1968: Ground Water, v. 6, no. 6, p. 35, 1968.

Brand's comments on Herbert's paper (ibid., no. 2, p. 12–18, 1968) are relevant to the interpretation of pumping test results. The hydraulics of unconfined aquifers pose these problems: delayed yield from storage, differentiation between occurrence of delayed yield and aquifer recharge, and variation of the coefficient of storage of aquifers with time and distance from the discharging well. The technique described in the paper can be used only for simulation of idealized aquifer conditions, but analogs when used with full-scale tests can assist greatly. Observation wells fail to record true elevations only where appreciable error results from deep penetration into the aquifer.—ESL

Bray, R. C. E. *See* Brooks, L. S. 05316

Breck, D. W. *See* Gibbs, G. V. 05645

05619 **Brenner, Robert L.** The geology of Lubrecht Experimental Forest—Lubrecht Ser. 1: Missoula, Mont., Univ. Montana, Forest and Conserv. Expt. Sta., 71 p., illus., tables, geol. map, 1968.

The Lubrecht Experimental Forest is underlain by several thousand feet of Precambrian Belt metasediments, Cambrian strata, Tertiary basin deposits, and Quaternary glacial and alluvial deposits. Precambrian and Cambrian rocks were intruded by plutonic and hypabyssal igneous rocks during Late-Cretaceous–early Tertiary times. An unconformity at the Cambrian base represents a period of erosion; younger Paleozoic and Mesozoic strata have been cut by intrusion or removed by erosion. Major structures, the E-SE plunging Elk Creek syncline and subparallel Cap Wallace faults, are attributed to Laramide deformation. Quartz monzonite magma intruded Belt and Cambrian rocks, forming the Garnet stock and smaller plutons. The only resource exploited is barite, placer gold and small amounts of other metals have been recovered, and limestone and gravel are potential resources.—*from* Author's abstract

05191 **Brett, Robin.** Opaque minerals in drill cuttings from Meteor Crater, Arizona, *in* Geological Survey research 1968, Chap. D: U.S. Geol. Survey Prof. Paper 600-D, p. D179–D180, 1968.

In the early years of this century, 25 holes were drilled in the floor of Meteor Crater, Ariz., to depths of 550–650 feet. Recently obtained deep cuttings from three of these drill holes contain nickel–iron fragments; nickel–iron spherules surrounded by glass; iron fragments; iron plus hematite and iron plus goethite intergrowths cementing sandstone grains; and magnetite and fayalite plus glass, and wüstite plus fayalite, in eutecticlike intergrowths. Electron microprobe analyses indicated that most of the metal fragments were drill steel, the rest were from the Canyon Diablo meteorite. Impact metamorphism was apparently intense to depths of 650 feet below the present crater floor.—Author's abstract

05603 **Briggs, Louis I., Jr.** Geology of subsurface waste disposal in Michigan basin, *in* Subsurface disposal in geologic basins—A study of reservoir strata: Am. Assoc. Petroleum Geologists Mem. 10, p. 128–153, illus., tables, 1968.

The deepest part of the Michigan basin contains about 14,000 feet of Paleozoic rocks. Four sequences of sedimentary formations can be distinguished: Cambrian sandstone, the carbonate–evaporite sequence of the Ordovician to Middle Devonian, the Late Devonian to Mississippian shale–sandstone sequence, and the Pennsylvanian coal–bearing sequence. The Cambrian Mt. Simon sandstones, which have the most favorable properties for high–volume waste disposal, are thick and shallow in the Detroit area. The formation is a feldspathic, quartzose sandstone, characterized by quartz and feldspar cement, and detrital and matrix carbonate minerals. Porosity averages about 10 percent and permeability about 30 md. These beds are overlain by an extensive shale layer.—*from* Author's abstract

05625 **Brock, Maurice R.** Terrestrial application of geological techniques developed for manned lunar exploration, *in* Internat. Geol. Cong., 23d, Prague, 1968, Proc., Sec. 13, Other subjects: Prague, Academia, p. 127–130, 1968.

Concepts for manned geological investigations on the lunar surface that can profitably be applied to terrestrial investigations include: preliminary mapping and preplanning by photogeologic methods, integrated application of geological and geophysical methods to study of a geologic problem, miniaturization and automation of surveying systems and analytical instruments for field use, and use of a data faciity to record, analyze, and compile information transmitted from remote field sites rapidly enough to incorporate the information into day–by–day planning. Modifications in instrumentation and techniques for lunar exploration will be required in application for terrestrial use. Problems inherent in application are under study by the U.S. Geological Survey.—*from* Author's abstract

05407 **Brockie, Douglas C.; Hare, Edward H., Jr.; Dingess, Paul R.** The geology and ore deposits of the Tri–State district of Missouri, Kansas, and Oklahoma, *in* Ore deposits of the United States, 1933–1967 (Graton–Sales Volume), V. I: New York, Am. Inst. Mining, Metall. and Petroleum Engineers, p. 400–430, illus., tables, 1968.

Tri–State district ores occur in Mississippian limestones containing abundant chert; zinc is 5 to 6 times more abundant than lead. In the Picher field, most of the ore has been mined from a single horizon, M bed. Most ore bodies, other than those of the "Sheet Ground", or blanket type, are in large, essentially flat–lying breccia zones, and have a definite mineral zonal pattern. An irregular, generally elongated central dolomitic core is surrounded progressively outward by the main ore run, the jasperoid zone, the muddy or shaly and bouldery zone, the sparry calcite limestone zone, and the fossiliferous limestone zone. Great controversy exists over the genesis, paragenesis, and emplacement time of the ore; these are discussed in the paper.—*from* Authors' abstract

05514 **Bromery, Randolph Wilson.** Geological interpretation of aeromagnetic and gravity surveys of the northeastern end of the Baltimore–Washington anticlinorium, Harford, Baltimore, and part of Carroll County, Maryland [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 29, no. 5, p. 1727B, 1968.

05316 **Brooks, L. S.; Bray, R. C. E.** A study of the tonnage and grade calculations at the Geco Division of Noranda Mines, *in* Ore reserve estimation and grade control—Canadian Centennial Conf., Quebec, 1967: Canadian Inst. Mining and Metallurgy Spec. Vol. 9, p. 177–182, illus., tables, 1968.

The Geco mine, in northwestern Ontario, produced, from September 1957 to the end of 1966, 12,142,000 tons of ore; present production is 4,000 tons daily. The steeply dipping, tabular orebody with a strike length of over 2,500 feet and a width of 65 feet, consists of a core of massive sulphides surrounded by an envelope of disseminated sulphides. Ore limits are established by diamond drilling, and reserve estimates and ring-grade calculations based on it. Production from several completed stopes shows a consistent over-run of zinc. Possible sources of the error are suggested.—*from* Authors' abstract

05493 **Brown, I. C.** Canadian federal ground water network [with French and Spanish abs.], *in* Water for peace—Internat. Conf., Washington, D.C., 1967—V. 4, Water supply technology: Washington, D.C., U.S. Govt. Printing Office, p. 502–511, 1968.

Present Canadian federal (management) and provincial (resources) networks are not extensive; continuous records of ground-water fluctuations go back only to 1945 and are available for limited areas. The six major hydrogeologic regions, approximating closely the geologic regions, are further subdivided on the basis of surface water drainage basins; small representative basins will be studied intensively to provide data for the network design. Purposes of the network are: to determine natural ground-water levels and amount and frequency of changes to evaluate causes, to determine changes in ground-water storage and predict levels, to instrument undeveloped aquifers for data needed in planning, and to make results available to the public. Choice of well installations, methods of recording data, and storage and retrieval of data are explained.—MCM

Brown, I. C. *See* Stockwell, C. H. 05653

Brown, I. C. *See* Stockwell, C. H. 05654

Brown, J. M. *See* Radabaugh, R. E. 05401

05428 **Brown, John S.** Ore deposits of the northeastern United States, *in* Ore deposits of the United States, 1933–1967 (Graton-Sales Volume), V. 1: New York, Am. Inst. Mining, Metall. and Petroleum Engineers, p. 1–19, illus., tables, 1968.

Although not noted as a metal mining area, the region does contain numerous substantial and several outstanding mines, chiefly the more prosaic metals, particularly iron, zinc, and copper, as well as many minor occurrences of these and a few additional items. These deposits occur to some extent in every subdivision of the region. The region to 1966 has produced almost 500 million tons of iron, especially magnetite, including ilmenitic magnetite, 50 million tons of high-grade zinc ore, and 5 million tons of low-grade copper. In the past it has yielded small amounts of chromite and nickel, and at present is a large producer of titanium. Precious metals are conspicuously absent.—*from* Author's abstract

05613 **Brown, Randy.** Computational photogrammetry and its impact on oil mapping, *in* Internat. Oil Scouts Assoc., 45th Ann. Mtg., San Antonio, Tex., 1968: Austin, Tex., Internat. Oil Scouts Assoc., p. 38–40, 1968.

The oil industry is involved in a new field of endeavor called computer graphics, digitizing all information from maps. The end results include geological and geophysical contours, graphs and charts, and fiscal reports. If the well data fed into the computer is invalid, then anything else that is done is wasted. The role of scouts in this undertaking is discussed, stressing need for accurate information. The computer can find many errors, but the writer feels that oil scouts are more important than ever before.—ESL

05423 **Brown, W. Horatio; Weinberg, Edgar L.** Geology of the Austinville–Ivanhoe district, Virginia, *in* Ore deposits of the United States, 1933–1967 (Graton-Sales Volume), V. 1: New York, Am. Inst. Mining, Metall. and Petroleum Engineers, p. 169–186, illus., tables, 1968.

The Austinville–Ivanhoe lead–zinc deposit occurs in the Lower Cambrian Shady Dolomite in southwestern Virginia in the faulted and folded Appalachian Valley and Ridge province. The orebodies resemble the chimney and manto deposits of

northern Mexico, are formed by replacement and filling, and are confined to certain favorable zones of the Austinville and Ribbon Members of the Shady. Structural and stratigraphic factors combine to control the location and form of orebodies. In certain places secondary oxide enrichment of the zinc minerals has contributed to the economic development of the area. It is concluded that the ore is epigenetic and is deposited by hydrothermal solutions rising through the fault "plumbing". Classification is epithermal–telethermal.—*from* Authors' abstract

05578 **Brownfield, James.** The peridotite dike of Fayette and Greene Counties, Pennsylvania [abs.]: West Virginia Acad. Sci. Proc. 1968, v. 40, p. 235–236, 1968.

Brummett, Richard W. *See* Dubois, Robert L. 05362

05450 **Buchbinder, Goetz G. R.** Amplitude spectra of PcP and P phases: Seismol. Soc. America Bull., v. 58, no. 6, p. 1797–1819, illus., tables, 1968.

Amplitude spectrums were obtained from short-period PcP and P phases from 7 explosions and 6 earthquakes. Long period PcP and P amplitude spectrums were obtained from 2 earthquakes. All PcP and P amplitude spectrums are similar for any one event; therefore, station and core-mantle boundary effects are small and the general shape of the spectrums is related to the source. The characteristics of the spectrums may be of help in the classification of sources. On a plot of magnitude versus period of the minimum in the spectrum of explosions, the data form a straight line; earthquakes with an amplitude spectrum similar to that of an explosion are randomly distributed on the plot. Systematic effects of focal depth were not observed. Layering at the core-mantle boundary was not detected.—*from* Author's abstract

05856 **Bunte, Enid.** Arnold S. Bunte (1902–1968): Am. Assoc. Petroleum Geologists Bull., v. 52, no. 12, p. 2502, portrait, 1968.

05388 **Burbank, Wilbur S.; Luedke, Robert G.** Geology and ore deposits of the western San Juan Mountains, Colorado, *in* Ore deposits of the United States, 1933–1967 (Graton-Sales Volume), V. 1: New York, Am. Inst. Mining, Metall. and Petroleum Engineers, p. 714–733, illus., tables, 1968.

Tertiary volcanism built a great plateau surrounding the San Juan volcanic depression, a complex of subsided blocks in the vent areas. The Silverton and Lake City calderas were domed by resurgent magmas that created keystone grabens and many post-cauldron radial and concentric fractures, dikes, and plutons. The ore deposits, localized mainly in the radial and concentric fractures and in the graben faults, include fissure veins, chimneys, replacements, and disseminations in volcanic and underlying basement rocks. Fissure veins constitute the most important source for precious- and base-metals. Most veins contain sphalerite, galena, and chalcopyrite, and some silver-bearing arsenical sulfosalts and free gold. The bulk of the ores are hypogene and probably had their origin in the deep parent magmas of the shallow eruptive rocks.—*from* Authors' abstract

05320 **Butler, F. C.** Ore reserve estimation and grade control at the Hollinger mine, *in* Ore reserve estimation and grade control—Canadian Centennial Conf., Quebec, 1967: Canadian Inst. Mining and Metallurgy Spec. Vol. 9, p. 203–208, illus., tables, 1968.

Ore in the Hollinger mine, Ontario, is contained in a complex vein system in folded and faulted volcanic rocks near an intrusive mass of porphyry; ore varies in grade from 0.15 to 2.0 oz of gold per ton. Reserve estimation is done annually; work done during the year is plotted on longitudinal sections. Prints are made and unmined sections of ore are blocked with colored crayon and measurements and grades printed on each block; information on the prints is summarized on longitudinal section cards to obtain a total tonnage and grade for the mine. Relationships between ore reserves, annual production plan, and grade control are reviewed.—ESL

05329 **Cairns, R. B.** Calculation of ore reserves in the Coronation mine, *in* Ore reserve estimation and grade control—Canadian Centennial Conf., Quebec, 1967: Canadian Inst. Mining and Metallurgy Spec. Vol. 9, p. 144–146, illus., 1968.

The Coronation copper sulfide deposit [Saskatchewan] was delineated by 55 diamond drill holes, which gave a reserve figure of 825,000 tons of 5.08 percent copper. Development work and drilling of 261 underground holes furnished data for a revised estimate based on 90 ore reserve blocks; subsequent revision involved up to 150 blocks and occupied one week of a geologists's time. When the orebody was completely mined out, production had amounted to 1,412,861 tons grading 4.25 percent copper which yielded 43 percent more copper metal than originally estimated, due partly to lowering of the cut-off grade. The original estimate proved to be a realistic one on which to base production plans. A computerized data processing technique is not warranted in evaluation of a deposit of this size and type.—*from* Author's abstract

05255 **Callahan, William H.** Memorial to W. Horatio Brown, 3d (1899–1966): Geol. Soc. America Proc. 1966, p. 191–193, portrait, 1968.

05419 **Callahan, William H.** Geology of the Friedensville zinc mine, Lehigh County, Pennsylvania, *in* Ore deposits of the United States, 1933–1967 (Graton-Sales Volume), V. 1: New York, Am. Inst. Mining, Metall. and Petroleum Engineers, p. 95–107, illus., table, 1968.

The Beekmantown Formation (Lower Ordovician) is the host for zinc and limonite ores, the former occurring in the lower dolomitic portion and the latter in the upper dolomite and limestone interbedded portion. The major structure is a N. 60° E.-trending and saddle-shaped doubly plunging anticline overturned to the north. The ore is sphalerite and pyrite along with gangue dolomite and quartz, filling and replacing sedimentary matrix in a solution-collapse breccia. The deposits are present on the vertical north limb, on the crest, and on the gently-dipping (25°) south limb of the anticline; this supports the view that the folding is post-ore. Other evidence supports the view that the ore is Ordovician in age and older than the Taconic orogeny. Submarine volcanic exhalations may have been the source of the metal ions.—*from* Author's abstract

Campbell, T. H. *See* Stolte, W. J. 05439

05256 **Canada Geological Survey.** Aeromagnetic series, Sheet 43 M/11, District of Kenora, Ontario: Canada Geol. Survey Geophysics Paper 3821, scale 1:63,360, 1968.

05257 **Canada Geological Survey.** Aeromagnetic series, West, Pen Island, Kenora and Winnipeg mining districts, Ontario-Manitoba: Canada Geol. Survey Geophysics Paper 3781, scale 1:63,360, 1968.

05775 **Canada Geological Survey.** Aeromagnetic series, Lac du Bonnet, Manitoba: Canada Geol. Survey Geophysics Paper 4094, scale 1:63,360, 1968.

05776 **Canada Geological Survey.** Aeromagnetic series, Pine Falls, Manitoba: Canada Geol. Survey Geophysics Paper 4095, scale 1:63,360, 1968.

05777 **Canada Geological Survey.** Aeromagnetic series, Black River, Manitoba: Canada Geol. Survey Geophysics Paper 4096, scale 1:63,360, 1968.

05778 **Canada Geological Survey.** Aeromagnetic series, Red River Delta, Manitoba: Canada Geol. Survey Geophysics Paper 4118, scale 1:63,360, 1968.

05779 **Canada Geological Survey.** Aeromagnetic series, Victoria Beach, Manitoba: Canada Geol. Survey Geophysics Paper 4119, scale 1:63,360, 1968.

05780 **Canada Geological Survey.** Aeromagnetic series, Riverton, Manitoba: Canada Geol. Survey Geophysics Paper 4120, scale 1:63,360, 1968.

05781 **Canada Geological Survey.** Aeromagnetic series, Teulon, Manitoba: Canada Geol. Survey Geophysics Paper 4142, scale 1:63,360, 1968.

05782 **Canada Geological Survey.** Aeromagnetic series, Gimli, Manitoba: Canada Geol. Survey Geophysics Paper 4143, scale 1:63,360, 1968.

05783 **Canada Geological Survey.** Aeromagnetic series, Arborg, Manitoba: Canada Geol. Survey Geophysics Paper 4144, scale 1:63,360, 1968.

05784 **Canada Geological Survey.** Aeromagnetic series, St. Laurent, Manitoba: Canada Geol. Survey Geophysics Paper 4162, scale 1:63,360, 1968.

05785 **Canada Geological Survey.** Aeromagnetic series, Narcisse, Manitoba: Canada Geol. Survey Geophysics Paper 4163, scale 1:63,360, 1968.

05786 **Canada Geological Survey.** Aeromagnetic series, Poplarfield, Manitoba: Canada Geol. Survey Geophysics Paper 4164, scale 1:63,360, 1968.

05787 **Canada Geological Survey.** Aeromagnetic series, MacDonald, Manitoba: Canada Geol. Survey Geophysics Paper 4177, scale 1:63,360, 1968.

05788 **Canada Geological Survey.** Aeromagnetic series, St. Ambroise, Manitoba: Canada Geol. Survey Geophysics Paper 4178, scale 1:63,360, 1968.

05789 **Canada Geological Survey.** Aeromagnetic series, Lundar, Manitoba: Canada Geol. Survey Geophysics Paper 4179, scale 1:63,360, 1968.

05790 **Canada Geological Survey.** Aeromagnetic series, Eriksdale, Manitoba: Canada Geol. Survey Geophysics Paper 4180, scale 1:63,360, 1968.

05791 **Canada Geological Survey.** Aeromagnetic series, Ashern, Manitoba: Canada Geol. Survey Geophysics Paper 4181, scale 1:63,360, 1968.

05792 **Canada Geological Survey.** Aeromagnetic series, Moosehorn, Manitoba: Canada Geol. Survey Geophysics Paper 4182, scale 1:63,360, 1968.

05793 **Canada Geological Survey.** Aeromagnetic series, Lake St. Martin, Manitoba: Canada Geol. Survey Geophysics Paper 4183, scale 1:63,360, 1968.

05794 **Canada Geological Survey.** Aeromagnetic series, Dauphin River, Manitoba: Canada Geol. Survey Geophysics Paper 4184, scale 1:63,360, 1968.

05795 **Canada Geological Survey.** Aeromagnetic series, Gladstone, Manitoba: Canada Geol. Survey Geophysics Paper 4193, scale 1:63,360, 1968.

05796 **Canada Geological Survey.** Aeromagnetic series, Langruth, Manitoba: Canada Geol. Survey Geophysics Paper 4194, scale 1:63,360, 1968.

05797 **Canada Geological Survey.** Aeromagnetic series, Amaranth, Manitoba: Canada Geol. Survey Geophysics Paper 4195, scale 1:63,360, 1968.

05798 **Canada Geological Survey.** Aeromagnetic series, Alonsa, Manitoba: Canada Geol. Survey Geophysics Paper 4196, scale 1:63,360, 1968.

05799 **Canada Geological Survey.** Aeromagnetic series, Ebb and Flow, Manitoba: Canada Geol. Survey Geophysics Paper 4197, scale 1:63,360, 1968.

05800 **Canada Geological Survey.** Aeromagnetic series, Steep Rock, Manitoba: Canada Geol. Survey Geophysics Paper 4198, scale 1:63,360, 1968.

05801 **Canada Geological Survey.** Aeromagnetic series, Fairford, Manitoba: Canada Geol. Survey Geophysics Paper 4199, scale 1:63,360, 1968.

05802 **Canada Geological Survey.** Aeromagnetic series, Gypsumville, Manitoba: Canada Geol. Survey Geophysics Paper 4200, scale 1:63,360, 1968.

05803 **Canada Geological Survey.** Aeromagnetic series, McCreary, Manitoba: Canada Geol. Survey Geophysics Paper 4209, scale 1:63,360, 1968.

05804 **Canada Geological Survey.** Aeromagnetic series, Valpoy, Manitoba: Canada Geol. Survey Geophysics Paper 4210, scale 1:63,360, 1968.

05805 **Canada Geological Survey.** Aeromagnetic series, Guynemer, Manitoba: Canada Geol. Survey Geophysics Paper 4211, scale 1:63,360, 1968.

05806 **Canada Geological Survey.** Aeromagnetic series, Crane Bay, Manitoba: Canada Geol. Survey Geophysics Paper 4212, scale 1:63,360, 1968.

05807 **Canada Geological Survey.** Aeromagnetic series, Proulx Lake, Manitoba: Canada Geol. Survey Geophysics Paper 4213, scale 1:63,360, 1968.

05808 **Canada Geological Survey.** Aeromagnetic series, Ochre River, Manitoba: Canada Geol. Survey Geophysics Paper 4222, scale 1:63,360, 1968.

05809 **Canada Geological Survey.** Aeromagnetic series, Rorketon, Manitoba: Canada Geol. Survey Geophysics Paper 4223, scale 1:63,360, 1968.

05810 **Canada Geological Survey.** Aeromagnetic series, Winnipegosis, Manitoba: Canada Geol. Survey Geophysics Paper 4224, scale 1:63,360, 1968.

05811 **Canada Geological Survey.** Aeromagnetic series, Skownan, Manitoba: Canada Geol. Survey Geophysics Paper 4225, scale 1:63,360, 1968.

05812 **Canada Geological Survey.** Aeromagnetic series, Garland, Manitoba: Canada Geol. Survey Geophysics Paper 4234, scale 1:63,360, 1968.

05813 **Canada Geological Survey.** Aeromagnetic series, Sagemace Bay, Manitoba: Canada Geol. Survey Geophysics Paper 4235, scale 1:63,360, 1968.

05814 **Canada Geological Survey.** Aeromagnetic series, Duck Bay, Manitoba: Canada Geol. Survey Geophysics Paper 4236, scale 1:63,360, 1968.

05815 **Canada Geological Survey.** Aeromagnetic series, Camping Islands, Manitoba: Canada Geol. Survey Geophysics Paper 4237, scale 1:63,360, 1968.

05816 **Canada Geological Survey.** Aeromagnetic series, Kircro Lake, Manitoba: Canada Geol. Survey Geophysics Paper 4238, scale 1:63,360, 1968.

05817 **Canada Geological Survey.** Aeromagnetic series, Lenswood, Manitoba: Canada Geol. Survey Geophysics Paper 4244, scale 1:63,360, 1968.

05818 **Canada Geological Survey.** Aeromagnetic series, Pelican Rapids, Manitoba: Canada Geol. Survey Geophysics Paper 4245, scale 1:63,360, 1968.

05819 **Canada Geological Survey.** Aeromagnetic series, Lac Hermas, Quebec: Canada Geol. Survey Geophysics Paper 4943, scale 1:63,360, 1968.

05820 **Canada Geological Survey.** Aeromagnetic series, Lac Guinecourt, Quebec: Canada Geol. Survey Geophysics Paper 4944, scale 1:63,360, 1968.

05821 **Canada Geological Survey.** Aeromagnetic series, Lac Tetepisca, Quebec: Canada Geol. Survey Geophysics Paper 4945, scale 1:63,360, 1968.

05822 **Canada Geological Survey.** Aeromagnetic series, Lac Mouchalagane, Quebec: Canada Geol. Survey Geophysics Paper 4946, scale 1:63,360, 1968.

05823 **Canada Geological Survey.** Aeromagnetic series, Lac Landriaux, Quebec: Canada Geol. Survey Geophysics Paper 4947, scale 1:63,360, 1968.

05824 **Canada Geological Survey.** Aeromagnetic series, Lac Salières, Quebec: Canada Geol. Survey Geophysics Paper 4948, scale 1:63,360, 1968.

05825 **Canada Geological Survey.** Aeromagnetic series, Lac Gaillard, Quebec: Canada Geol. Survey Geophysics Paper 4959, scale 1:63,360, 1968.

05826 **Canada Geological Survey.** Aeromagnetic series, Lac Okaopéo, Quebec: Canada Geol. Survey Geophysics Paper 4960, scale 1:63,360, 1968.

05827 **Canada Geological Survey.** Aeromagnetic series, Lac de la Cache, Quebec: Canada Geol. Survey Geophysics Paper 4961, scale 1:63,360, 1968.

05828 **Canada Geological Survey.** Aeromagnetic series, Lac Bois-Long, Quebec: Canada Geol. Survey Geophysics Paper 4962, scale 1:63,360, 1968.

05829 **Canada Geological Survey.** Aeromagnetic series, Lac Lacoste, Quebec: Canada Geol. Survey Geophysics Paper 4963, scale 1:63,360, 1968.

05830 **Canada Geological Survey.** Aeromagnetic series, Mont de Babel, Quebec: Canada Geol. Survey Geophysics Paper 4964, scale 1:63,360, 1968.

05831 **Canada Geological Survey.** Aeromagnetic series, Lac du Chaunoy, Quebec: Canada Geol. Survey Geophysics Paper 4965, scale 1:63,360, 1968.

05832 **Canada Geological Survey.** Aeromagnetic series, Lac Pecaudy, Quebec: Canada Geol. Survey Geophysics Paper 4966, scale 1:63,360, 1968.

05833 **Canada Geological Survey.** Aeromagnetic series, Lac Saint-Pierre, Quebec: Canada Geol. Survey Geophysics Paper 4975, scale 1:63,360, 1968.

05834 **Canada Geological Survey.** Aeromagnetic series, Lac Clairval, Quebec: Canada Geol. Survey Geophysics Paper 4976, scale 1:63,360, 1968.

05835 **Canada Geological Survey.** Aeromagnetic series, Lac Lemay, Quebec: Canada Geol. Survey Geophysics Paper 4977, scale 1:63,360, 1968.

05836 **Canada Geological Survey.** Aeromagnetic series, Lac Mistachagane, Quebec: Canada Geol. Survey Geophysics Paper 4978, scale 1:63,360, 1968.

05837 **Canada Geological Survey.** Aeromagnetic series, Lac Mathevet, Quebec: Canada Geol. Survey Geophysics Paper 4979, scale 1:63,360, 1968.

05838 **Canada Geological Survey.** Aeromagnetic series, Lac Manicouagan, Quebec: Canada Geol. Survey Geophysics Paper 4980, scale 1:63,360, 1968.

05839 **Canada Geological Survey.** Aeromagnetic series, Rivière Hart-Jaune, Quebec: Canada Geol. Survey Geophysics Paper 4981, scale 1:63,360, 1968.

05840 **Canada Geological Survey.** Aeromagnetic series, Lac Barbel, Quebec: Canada Geol. Survey Geophysics Paper 4982, scale 1:63,360, 1968.

05841 **Canada Geological Survey.** Aeromagnetic series, Lac Sainte-Anne, Quebec: Canada Geol. Survey Geophysics Paper 4991, scale 1:63,360, 1968.

05842 **Canada Geological Survey.** Aeromagnetic series, Lac Beaudin, Quebec: Canada Geol. Survey Geophysics Paper 4992, scale 1:63,360, 1968.

05843 **Canada Geological Survey.** Aeromagnetic series, Lac Bouffard, Quebec: Canada Geol. Survey Geophysics Paper 4993, scale 1:63,360, 1968.

05844 **Canada Geological Survey.** Aeromagnetic series, Lac Fortin, Quebec: Canada Geol. Survey Geophysics Paper 4994, scale 1:63,360, 1968.

05845 **Canada Geological Survey.** Aeromagnetic series, Lac Grandmesnil, Quebec: Canada Geol. Survey Geophysics Paper 4996, scale 1:63,360, 1968.

05846 **Canada Geological Survey.** Aeromagnetic series, Petit Lac Manicouagan, Quebec: Canada Geol. Survey Geophysics Paper 4998, scale 1:63,360, 1968.

05847 **Canada Geological Survey.** Aeromagnetic series, Lac Vermette, Quebec: Canada Geol. Survey Geophysics Paper 5007, scale 1:63,360, 1968.

05848 **Canada Geological Survey.** Aeromagnetic series, Lac Walker, Quebec: Canada Geol. Survey Geophysics Paper 5008, scale 1:63,360, 1968.

05849 **Canada Geological Survey.** Aeromagnetic series, Grand Lac du Nord, Quebec: Canada Geol. Survey Geophysics Paper 5010, scale 1:63,360, 1968.

05850 **Canada Geological Survey.** Aeromagnetic series, Lac Garemand, Quebec: Canada Geol. Survey Geophysics Paper 5011, scale 1:63,360, 1968.

05851 **Canada Geological Survey.** Aeromagnetic series, Lac Catoua, Quebec: Canada Geol. Survey Geophysics Paper 5012, scale 1:63,360, 1968.

05852 **Canada Geological Survey.** Aeromagnetic series, Rivière de la Montagne-Blanche, Quebec: Canada Geol. Survey Geophysics Paper 5013, scale 1:63,360, 1968.

05853 **Canada Geological Survey.** Aeromagnetic series, Lac Gaillarbois, Quebec: Canada Geol. Survey Geophysics Paper 5014, scale 1:63,360, 1968.

05854 **Canada Geological Survey.** Aeromagnetic series, Pointe Jambon, Quebec: Canada Geol. Survey Geophysics Paper 5022, scale 1:63,360, 1968.

05239 **Canadian Inst.Mining and Metallurgy.** Ore reserve estimation and grade control—Canadian Centennial Conf., Quebec, 1967: Canadian Inst. Mining and Metallurgy Spec. Vol. 9, 321 p., illus., tables, 1968.

Papers of the L'Esterel Conference, named from the city where it was held, are divided into two sections: general theory of ore reserve estimation and grade control and methods of application, and case histories. The first contains 12 papers, 9 of which are cited separately, and the second, 28, 25 of which are cited separately.—ESL

05472 **Caner, B.; Auld, D. R.** Magneto-telluric determination of upper mantle conductivity structure at Victoria, British Columbia: Canadian Jour. Earth Sci., v. 5, no. 5, p. 1209–1220, illus., 1968.

Magneto-telluric data were obtained at Victoria over a very wide range of periods (2 s to 86,400 s). Only the data up to 15,000 s periods were used for interpretation of conductivity structure, since telluric data at longer periods were dominated by ocean-tidal effects; spectral analysis of one year's data was used to demonstrate the tidal effects. The telluric signals are strongly polarized in the whole frequency range, indicating an anisotropy in surface conductivity. The data indicate the existence of a finite conducting layer 10 ± 3 km thick and resistivity 100–125 ohm-meters, at a depth of 65 ± 5 km. A high resistivity zone (of the order of 4,000-5,000 ohm-meters) lies below this layer. No evidence exists for any further conducting zones down to a depth of at least 750 km.—*from* Authors' abstract

Carbonnell, M. *See* Bauer, A. 05289

05305 **Carbonnell, M.** Exploitation des couvertures photographiques aériennes répétée du front des glaciers vêlant dans Disko Bugt et Umanak Fjord, Juin-Juillet 1964—[Pt.] 1, Nouvelles mesures photogrammétriques de la vitesse superficielle des glaciers du Groenland [with English abs.]: Medd. Grönland, v. 173, no. 5, p. 1–53, illus., tables, 1968.

This part of the study shows results of photogrammetric measurements taken in 1964 on repeated photographic coverage of the front of 16 glaciers calving into Disko Bugt and Umanak Fjord. The velocities of transverse profiles, and position and heights of the front are given for each glacier. Mean values of the velocity at the front of Jakobshavns Isbrae range between 0.9 and 19.1 m/24 hr.—*from* Author's abstract

05465 **Card, K. D.; Palonen, P.; Fox, J.** Bay of Islands-McGregor Bay area McGregor Bay sheet (west half and east half) (revised edition): Ontario Dept. Mines Prelim. Geol. Maps P. 442–443, scale 1 in. to 1/4 mil, text, 1968; originally published 1967.

For abstract of text, *see* Abstracts of North American Geology, July 1968.—MCM

05466 **Card, K. D.; Palonen, P.; Fox, J.** Louise Township and north part of Dieppe Township, District of Sudbury: Ontario Dept. Mines Prelim. Geol. Map P. 498, scale 1 in. to 1/4 mi., text, 1968.

Louise and northern Dieppe Townships are underlain by Precambrian rocks of probable Huronian age, cut by a variety of intrusive rocks and overlain unconformably by unconsolidated Cenozoic deposits. The Huronian(?) rocks display abundant crossbedding and ripple marks, indicating deposition under shallow-water, turbulent conditions. Five major folds are interrupted by faults of several orientations, and probably several ages. Zones containing abundant Sudbury-type breccias and shatter cones are folded. Regional metamorphism in the greenschist facies was broadly coincident with the major deformation. Exploration for base metals and gold has not disclosed deposits of commercial importance.—MCM

05467 **Card, K. D.; Palonen, P.; Fox, J.** Bay of Islands-McGregor Bay area—Frazer Bay sheet (west half and east half), District of Manitoulin: Ontario Dept. Mines Prelim. Geol. Maps P. 499-500, scale 1 in. to 1/4 mi., text, 1968.

Much of the Frazer Bay area is covered by waters of Lake Huron; Precambrian rocks occurring on peninsulas and islands extending southwest toward Manitoulin Island include metasediments of probable Huronian age, younger mafic intrusions, and granites and gneisses of the Grenville Province. Killarney granite, about 1,585 m.y. old, intrudes the Huronian rocks and, apparently, the amphibolite dikes. Main structural elements are the Frazer Bay anticline and the Killarney Bay fault. The Grenville front extends from northeast to southwest. The Killarney quarry has produced almost 5 million tons of orthoquartzite; present plans are to reactivate the quarry and to start a new operation on nearby Badgeley Island. Other areas should be investigated for quarrying granite, trap rock, and orthoquartzite.—MCM

Carleton, B. J. *See* Nagata, T. 05278

Carlier, Pierre A. *See* Blais, Roger A. 05226

05679 **Carlson, Keith J.** The skull morphology and estivation of burrows of the Permian lungfish, *Gnathorhiza serrata*: Jour. Geology, v. 76, no. 6, p. 641-663, illus., tables, 1968.

Many estivation (hibernation) burrows containing articulated skull bones of *G. serrata* are described from three localities in the dolomitic red and gray beds of the Wellington Formation of north-central Oklahoma. Based on dentitions, skull roof patterns, and on distinctive burrows, *Gnathorhiza* is proposed as an ancestral type leading to modern lepidosirenid lungfish; a second ancestral line, separate since the start of the Mesozoic, leads to the ceratodontid lungfish. The burrow form and lithologic relations suggest that *Gnathorhiza* used its mouth in burrowing and that it stood on its tail during estivation, living in floodplain pond or lake areas which were alternately wet and dry during Wellington time.—VES

05231 **Carlston, Charles W.** Slope-discharge relations for eight rivers in the United States, *in* Geological Survey research 1968, Chap. D: U.S. Geol. Survey Prof. Paper 600-D, p. D45-D47, illus., 1968.

Graphs showing slope versus mean annual discharge have been prepared for eight rivers in the United States, and eye-fitted lines were constructed for those rivers showing acceptable statistical correlation of slope with discharge. Two alluvial-bed graded rivers, the Red River of Louisiana and Arkansas and the Arkansas River, showed a very close correlation of slope varying with discharge. A third river, the Missouri, showed a slope-discharge relation of s varies as $Q_m^{0.0}$ for more than 1,800 miles upstream from its mouth. Two other rivers, the Tennessee-Holston and the Delaware, showed a good correlation of slope with discharge. The remaining three rivers—the Ohio, the Susquehanna, and the Alabama and its headwaters—showed no correlation of slope plotted against discharge.—Author's abstract

Carmichael, I. S. E. *See* Smith, A. L. 05294

Carpenter, H. C. *See* Tihen, S. S. 05664

05349 **Carpenter, Robert H.** Geology and ore deposits of the Questa molybdenum mine area, Taos County, New Mexico, *in* Ore deposits of the United States, 1933–1967 (Graton–Sales Volume), V. 2: New York, Am. Inst. Mining, Metall. and Petroleum Engineers, p. 1328–1350, illus., tables, 1968.

Molybdenite occurs in the hood zone of one of three aplite–porphyry intrusives which intruded a mid–Tertiary volcanic section of andesite, latite, and rhyolite, the andesite being mostly affected. The bodies were emplaced by metasomatism rather than stoping. Hydrothermal alteration occurs both as blanket propylitization in the volcanics, and sericitization and kaolinization in the porphyries. Mineralization consists of molybdenite–quartz veinlets, banded molybdenite quartz veins, high grade molybdenite locally along shear zones, and molybdenite paint along joint and fracture surfaces. The mineralization was associated with gravity faulting. The molybdenite has been well oxidized to ferromolybdite and akaganeite in near surface exposures.—*from* Author's abstract

05715 **Carroll, Robert L.; Baird, Donald.** The Carboniferous amphibian *Tuditanus (Eosauravus)* and the distinction between microsaurs and reptiles: Am. Mus. Novitates, no. 2337, 50 p., illus., tables, 1968.

The genus *Tuditanus (Eosauravus)* from the Middle Pennsylvanian of Linton, Ohio, is redescribed on the basis of the two type specimens. This animal, which has been considered alternatively a microsaurian amphibian and a primitive reptile, proves to be a microsaur. The anatomy of 11 microsaur genera is reviewed to determine whether any members of this group might be of reptilian ancestry. Information indicates that microsaurs could share a common ancestry with reptiles only at, or near, the level of rhipidistian fish and only in pre–Carboniferous time.—KAF

05553 **Carroll, Roderick D.** Velocity–porosity logging in volcanic rocks: Jour. Petroleum Technology, v. 20, no. 12, p. 1371–1374, illus., table, 1968.

Volcanic rocks exhibit a wide range in porosity and velocity and are an excellent medium for checking the time–average formula. An analysis of core porosity data and velocity logs from five wells at the Atomic Energy Commission's Nevada Test Site indicates that the time–average formula applies in these rocks. An equation with the constants $\Delta t_{ma} = 54$ μsec/ft; $\Delta t_f = 189$ μsec/ft best fits the data. The close agreement of this equation with that generally assumed for sandstones suggests that in volcanic rock areas, where porosity–velocity data are lacking, existing interpretation charts for sandstones, relating sonic–log traveltime to porosity, may be applied to these rocks.—Author's abstract

05568 **Carstea, D. D.** Formation of hydroxy–Al and –Fe interlayers in montmorillonite and vermiculite—Influence of particle size and temperature [with French, German, and Russian abs.]: Clays and Clay Minerals, v. 16, no. 3, p. 231–238, tables, 1968.

At comparable particle size, regardless of temperature, the amounts of interlayers formed in montmorillonite greatly exceed those formed in vermiculite. Aluminum systems exhibited a higher degree of interlayering than iron systems. Within montmorillonite, the amount of interlayers increased as particle size decreased, regardless of temperature. Within vermiculite systems equilibrated at 3°C, more hydroxy–Al interlayers were recorded in coarse clay than in silt, whereas at 21°C about equal amounts were formed. By contrast, hydroxy–Fe interlayering was favored by the silt fraction at both temperatures. The formation of aluminum interlayers in both minerals increased with increasing temperature. The formation of hydroxy–Fe interlayers in montmorillonite was generally not temperature dependent but in vermiculite increased slightly with increasing temperature.—*from* Editor's abstract

05687 **Carter, John L.** New genera and species of Early Mississippian brachiopods from the Burlington Limestone: Jour. Paleontology, v. 42, no. 5, p. 1140–1152, illus., tables, 1968.

Seven new species of articulate brachiopods from the Burlington Limestone of northeastern Missouri are described. *Caenanoplia burlingtonensis*, n.sp., and *Magnumbonella macrura*, n.sp., are type species for new genera. Other new species are *Leptagonia missouriensis, Marginatia magna, Unispirifer? corpulentus, Punctospirifer acutus*, and *Composita pikensis*. Most of the specimens occur in the lower Burlington "white chert" and are part of the R. R. Rowley Collection from Louisiana, Pike County, Mo. The brachiopod fauna of these beds appears to be an age equivalent of that of the earliest Osagian Fern Glen Formation.—*from* Author's abstract

05531 **Casshyap, S. M.** Sedimentary petrology and stratigraphy of the Huronian rocks, south of Espanola, Ontario [abs.]: Bull. Canadian Petroleum Geology, v. 16, no. 3, p. 419, 1968.

05762 **Cassidy, Martin M.** Reply [to discussion by D. M. Triplehorn of "Excello Shale, northeastern Oklahoma—Clue to locating buried reefs", 1968]: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 11, pt. 1, p. 2266, 1968.

Cassidy, in reply to Triplehorn (ibid., p. 2265), points out that as indicated in his original paper, study of the Excello Shale was set up to examine only the Oklahoma portion and that further research effort is necessary to define both the complete facies distribution in the shale and in surrounding formations. This shale is now under detailed study over the entire midcontinent region.—VSN

Chace, Frederic M. *See* Cumberlidge, John T. 05365

05457 **Chandler, Ramesh; Alsop, L. E.; Oliver, Jack.** On the synthesis of shear-coupled PL waves: Seismol. Soc. America Bull., v. 58, no. 6, p. 1849–1877, illus., table, 1968.

On the basis of Oliver's shear-coupled PL wave hypothesis (1961), a method is developed for computing synthetic long-period seismograms between the onset of the initial S-type body phase and the beginning of the surface waves. Comparison of observed and synthetic seismograms shows that this hypothesis can explain in considerable detail most of the waves with periods greater than 20 sec recorded during this interval. The synthetic seismograms resemble observed seismograms much more closely than those obtained by superposition of normal modes of the Earth. Phase-velocity curves of the PL wave can be determined if shear-wave traveltimes are well known; such curves are determined for various parts of the Earth. It is found that J-B traveltimes of shear waves along certain paths need to be revised.—DBV

05498 **Chang, Andre Chichao.** Love waves and the crust-upper mantle structure of the southwestern United States [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 29, no. 5, p. 1734B, 1968.

05171 **Chao, T. T.; Jenne, E. A.; Heppting, L. M.** Adsorption of traces of silver on sample containers, *in* Geological Survey research 1968, Chap. D: U.S. Geol. Survey Prof. Paper 600-D, p. D13–D15, illus., 1968.

Special care is required to prevent container adsorption of significant parts of the trace amount of silver present in most natural waters. The use of strong acids appears to be the most effective means of retaining the silver in solution. Lowering the pH of the water samples to 1 with either hydrochloric or nitric acid reduced adsorption onto polyethylene containers to approximately 1 percent of the silver present. Silver adsorption after 30 days of contact time amounted to 4 and 10 percent, of the silver present, at pH 2 when adjusted with hydrochloric acid and nitric acid, respectively. Adjustment of the pH to 1 with either hydrochloric or nitric acid was effective in desorbing silver from polyethylene containers in the course of several days.—Authors' abstract

05172 **Chao, T. T.; Jenne, E. A.; Heppting, L. M.** Prevention of adsorption of trace amounts of gold by containers, *in* Geological Survey research 1968, Chap. D: U.S. Geol. Survey Prof. Paper 600-D, p. D16-D19, illus., 1968.

Loss of significant parts of trace amounts of gold by adsorption on container walls during transport and storage is a major problem in quantitative determinations in natural water. Experiments using gold-198 as a tracer indicate that gold may be kept in solution for 21 days by acidification of a test solution to pH 1 with hydrochloric acid and addition of 5 to 50 mg per l of bromine, acidification with hydrochloric acid to 1N with bromine, and acidification with nitric acid to 2N or 3N. Addition of 50 mg per l of bromine to a nonacidified test solution of pH 6 is almost as effective. The pH 1 hydrochloric acid and 50 mg per l bromine combination is as effective in desorbing gold as it is in preventing adsorption.—*from* Authors' abstract

Charbonneau, B. W. *See* MacLaren, A. S. 05279

Charlesworth, H. A. K. *See* Robinson, J. E. 05618

Chaudhuri, S. *See* Faure, G. 00016

05657 **Chesterman, Charles W.** Francis H. Frederick [1907?-1968]: California Div. Mines and Geology Mineral Inf. Service, v. 21, no. 11, p. 169, portrait, 1968.

Chilingar, G. V. *See* Bissell, H. J. 05629

Christ, C. L. *See* Hostetler, P. B. 05198

05479 **Christiansen, E. A.** Pleistocene stratigraphy of the Saskatoon area, Saskatchewan, Canada: Canadian Jour. Earth Sci., v. 5, no. 5, p. 1167-1173, illus., 1968.

Pleistocene sediments in the Saskatoon area are subdivided into the Sutherland and Saskatoon Groups on the basis of dolomite content of tills. The Sutherland Group generally comprises one till, but locally it comprises a lower and upper till. The overlying Saskatoon Group comprises two tills, which are in ascending order—the Floral and Battleford Formations. Forty feet of partial leaching of carbonates in till in the upper part of the Sutherland Group suggests a hiatus of interglacial proportions. The hiatus between the deposition of the Floral and Battleford Formations is Mid-Wisconsin and the Battleford Formation is Woodfordian.—Author's abstract

05446 **Christiansen, Robert L.; Noble, Donald C.** Geologic map of the Trail Ridge quadrangle, Nye County, Nevada: U.S. Geol. Survey Geol. Quad. Map GQ-774, scale 1:24,000, sections, 1968.

Christianson, H. R. *See* Goldberg, Marvin C. 05173

00019 **Chronic, John; McCallum, Malcolm E.; Ferris, Clinton S., Jr.; Eggler, David H.** Lower Paleozoic rocks in diatremes, southern Wyoming and northern Colorado: Geol. Soc. America Bull., v. 80, no. 1, p. 149-156, illus., 1969.

Blocks of sedimentary rocks, in part fossiliferous, from five of twelve serpentinite diatremes in Precambrian crystalline rocks from the northern Front Range and southern Laramie Range near the Colorado-Wyoming border, indicate sedimentation during Early, Middle, and Late Ordovician, and Early, Middle, and Late Silurian times in this area, which had previously been assumed to have been above sea level during Ordovician and Silurian times. These blocks of sedimentary rock indicate intrusion of the diatremes prior to removal of Silurian rocks, which must have occurred before deposition of Pennsylvanian red beds and probably occurred before Devonian sedimentation.—WHN

00014 **Clark, David L.; Miller, James F.** Early evolution of conodonts: Geol. Soc. America Bull., v. 80, no. 1, p. 125-134, illus., table, 1969.

The known distribution of conodonts in the Cambrian of Europe, Asia, and North America is not uniform, but no major discrepancies in stratigraphic ranges of form species have been noted. The oldest reliably dated conodont is a *Hertzina* species from the upper Middle Cambrian of Nevada and Denmark. The conodont faunal distribution may be related to the Cambro-Ordovician trilobite biomeres, at least in North America. There, the first real diversification occurs in the *Aphelaspis-Elvinia* interval corresponding to the Pterocephaliid trilobite invasion. Similarly, the *Saukia* Trempealeauan = Lower Tremadocian trilobite fauna diversity has a counterpart in conodont fauna diversity. Form species evolution in this interval includes the *Cordylodus-Oistodus* group and a separate but related *Oneotodus-Acodus-Aconticodus* sequence.—*from* Authors' abstract

05213 **Clark, George S.; Kulp, J. Laurence.** Isotopic age study of metamorphism and intrusion in western Connecticut and southeastern New York: Am. Jour. Sci., v. 266, no. 10, p. 865–894, illus., tables, 1968.

K-Ar and Rb-Sr ages for a variety of metamorphic and igneous rock types are reported. K-Ar ages range from 480 m.y. to 240 m.y. Three metamorphic events affected the region. The earlier metamorphism probably occurred 460 to 480 m.y. ago; the second about 360 m.y. ago, and the third and latest about 255 m.y. ago. These ages correspond to the Taconic, Acadian, and Alleghanian orogenies. Ages reported in the literature on undeformed pegmatites and data from the present study on undeformed intrusions support this conclusion, although the data concerning the 255 m.y. event are not so conclusive. Rb-Sr whole-rock data on the Waterbury Formation give an isochron age of 465 ± 50 m.y. Although the data do not preclude a Precambrian age for the Waterbury gneiss dome, evidence to suggest a Grenville-type age is absent.—*from* Authors' abstract

05640 **Clark, Glenn A.; Meisler, Harold; Rhodehamel, Edward C.; Gill, Harold E.** Summary of ground-water resources of Atlantic County, New Jersey: New Jersey Div. Water Policy and Supply Water Resources Circ. 18, 53 p., illus., tables, 1968.

Atlantic County, in southeastern New Jersey in the Coastal Plain province, is underlain by unconsolidated Quaternary, Tertiary, and Cretaceous gravel, sand, silt, and clay. Principal fresh-water aquifers are in the Miocene Kirkwood Formation, tapped mostly by industrial and public supply wells with yields from 250–1,200 gpm; and in the Cohansey Sand which is used for many purposes with yields from 30–1,440 gpm. Water from both aquifers is generally low in dissolved solids and total hardness; pH of Cohansey water is generally acidic, of the Kirkwood, generally alkaline along the coast and acidic to the north. Along the coast, water from some Cohansey wells has constituents that indicate salt-water encroachment.—*from* Authors' abstract

05768 **Clark, Mary Gilman; Shaw, Alan B.** Paleontology of northwestern Vermont — [Pt.] 16, Trilobites of the Upper Cambrian Gorge Formation (upper Bed 3): Jour. Paleontology, v. 42, no. 4, p. 1014–1026, illus., tables, 1968.

The upper part of Bed 3 of the type section of the Gorge Formation (Upper Cambrian) has yielded 15 kinds of trilobites, of which all but one [*Plethometopus* sp.] are previously described species. Four unnamed pygidia are also present. The fauna is characteristic of that described by P. E. Raymond in 1924, 1925, and 1937 from the lower zone (or Zone 1) of the same formation, which has been commonly referred to as the *Hungaia magnifica* fauna.—Author's abstract

Clark, Robert. *See* Alford, Donald. 05609

05732 **Clark, Thomas H.; Stearn, Colin W.** Geological evolution of North America (2d edition): New York, Ronald Press Co., 570 p., illus., 1968; originally published 1960.

This textbook for first-year students uses the regional approach to present the regional geology of North America in conjunction with methods by which the stratigrapher and paleontologist interpret the record of the rocks. The historical development of the bordering geosynclines, the platform, and the Canadian Shield is considered through a major part of geological time to enable the student to

recognize similarities and important differences in patterns of behavior of the various structural elements. The six main divisions of the book are: methods and problems of historical geology, North American craton, backbone of North America, Appalachian geosyncline, continental nucleus and northland, and evolution of life. Appendixes contain a summary of the plant and animal kingdoms, and a simplified classification of plants and animals.—MCM

05489 **Clarke, Frank E.** Significance of corrosion in water well development [with French and Spanish summ.], *in* Water for peace—Internat. Conf., Washington, D.C., 1967—V. 3, Water supply technology: Washington, D.C., U.S. Govt. Printing Office, p. 93–105, illus., 1968.

Ground-water storage is becoming increasingly important not only in desert areas, but also in humid climates, monsoon belts, coastal areas, and for artificial recharge. While attention to hydraulic factors of well design has been relatively good, unexpected corrosion and related mineral deposition have reduced well efficiency and well life in many major well fields, sometimes with serious results. Effect of corrosion is intensified by the disturbance of chemical equilibria, causing a variety of troublesome minerals to separate from the water and to collect on surfaces of well screens and casings. Water can be extremely corrosive even when its pH value is well above the neutral point of 7. Type 304 stainless steel, and modern high-strength plastics are suitable alternatives for carbon steel for general use.—MCM

05269 **Clayton, R. N.; Muffler, L. J. P.; White, Donald E.** Oxygen isotope study of calcite and silicates of the River Ranch No. 1 well, Salton Sea geothermal field, California: Am. Jour. Sci., v. 266, no. 10, p. 968–979, illus., table, 1968.

The effect of temperature variation on isotope fractionation has been studied in rock samples from a well in the Salton Sea geothermal area. A vertical profile of oxygen isotopic composition of whole rock and separated minerals shows extensive exchange between hydrothermal solutions and the country rock. Carbonates and silicates have reached isotopic equilibrium at temperatures as low as 150° and possibly down to 100°C. In contrast to calcite, detrital quartz is remarkably resistant to isotopic exchange at temperatures as high as 340°C. For the main Salton Sea geothermal reservoir, at depths of about 3000 to 6000 feet, the volumes of water and rock that have undergone exchange are roughly equal.—Authors' abstract

Clayton, Robert L. *See* Baker, Arthur, 3d. 05348

Cleary, J. R. *See* Hales, A. L. 05461

Clendening, John A. *See* Jones, Michael L. 05582

Clippinger, D. M. *See* Eidel, J. J. 05430

05504 **Clissold, R. J.** Mapping of naturally occurring surficial phenomena to determine ground water conditions in two areas near Red Deer, Alberta [abs.]: Bull. Canadian Petroleum Geology, v. 16, no. 3, p. 415–416, 1968.

Cloud, W. H. *See* Bither, T. A. 05487

05522 **Coakley, J. P.** History and bottom sediments of Stanwell-Fletcher Lake, Somerset Island, N.W.T. [abs.]: Bull. Canadian Petroleum Geology, v. 16, no. 3, p. 422, 1968.

05725 **Coates, D. F.; Aslam, M.** The equations of state up to 250 kb of a magnetite and a quartzite: Internat. Jour. Rock Mechanics and Mining Sci., v. 5, no. 6, p. 495–500, illus., 1968.

In a research project on prediction of boundaries of fragmented rock resulting from blasting, the compressibilities of magnetite and quartzite were measured by the pin-contact technique; this provides information on propagation velocity of the shock front and particle velocity in shocked material. A polynomial regression analysis was used to obtain an empirical equation of state for each of the rocks. Magnetite

samples have a static uniaxial compressive strength of 2010 ksc, a modulus of deformation of 8.75×10^5 ksc and density of 3.7 g/cm^3. Quartzite has a uniaxial compressive strength of 2460 ksc and a modulus of deformation of 8.57×10^5 ksc. Variation of compressibility of magnetite with pressure was substantilly linear with resistance about 20 percent greater than under static compression; compressibility of quartzite decreases at about 80 kb.—*from* Authors' abstract

05375 **Coats, Robert R.; Stephens, Edward C.** Mountain City copper mine, Elko County, Nevada, *in* Ore deposits of the United States, 1933–1967 (Graton–Sales Volume), V. 2: New York, Am. Inst. Mining, Metall. and Petroleum Engineers, p. 1074–1101, illus., table, 1968.

The mine is developed in the Ordovician Valmy Formation. Several plutons of Cretaceous age intrude this and other Paleozoic formations; this sequence was eroded and covered with Miocene, Pliocene, and possibly older volcanic rocks. The primary mineralization of the area is believed to postdate the Mississippian Nelson Formation and pre-date the Cretaceous intrusives. The primary orebodies are lenticular in shape and are composed largely of quartz, pyrite, and chalcopyrite. The ore lenses, in general, strike northwestward and dip northward; they are in shales with associated minor quartzite lenses. The ore is epigenetic, and the principal orebody was leached to the 200-ft level; supergene copper sulfide ore was immediately below the barren gossan. The supergene enrichment of the ore may have required a large part of Tertiary time.—*from* Authors' abstract

05573 **Coch, Nicholas K.** Geology of the Benns Church, Smithfield, Windsor, and Chuckatuck quadrangles, Virginia: Virginia Div. Mineral Resources Rept. Inv. 17, 39 p., illus., geol. maps, 1968.

In this Coastal Plain area south of the James River, near Suffolk, unconsolidated sediments exposed are of late Miocene to Recent age. Oldest is the marine Yorktown Formation, overlain by transitional Sedley and Bacons Castle formations, their clastics and unconformity between them indicating tectonism in their western source area. Above are Pleistocene marine and estuarine units—Windsor, Norfolk, and Sand Bridge formations—each evidence of a different sea level. The Isle of Wight plain, overlying the Windsor, slopes gently eastward from the Surry to the east-facing Suffolk scarp capped by Norfolk sand facies. Churchland flat, to the east, is underlain by the Sand Bridge lagoonal-estuarine complex of a 17-ft sea level. The Suffolk scarp appears to have been a coastal shoreline in Norfolk time, intracoastal in Sand Bridge time. There is a geologic map for each quadrangle.—GDC

05763 **Cohee, George V.** Carle Hamilton Dane (1900–1968): Am. Assoc. Petroleum Geologists Bull., v. 52, no. 11, pt. 1, p. 2268–2269, portrait, 1968.

05624 **Cohen, C. L. D.; Reinhardt, P.** Coccolithophorids from the Pleistocene Caribbean deep-sea core CP-28: Neues Jahrb. Geologie u. Paläontologie Abh., v. 131, no. 3, p. 289–304, illus., 1968.

Eighteen coccolith and discoasterid species from the Pleistocene in Caribbean deep-sea core CP-28 have been investigated under the optical and electron microscopes and described. On the basis of the range of variations in *Umbilicosphaera mirabilis* Lohmann, the genus *Umbilicosphaera* is revised; a new genus *Oolithotus* is established for *Discolithus antillarum* Cohen.—DBV

00008 **Condie, Kent C.** Petrology and geochemistry of the Laramie batholith and related metamorphic rocks of Precambrian age, eastern Wyoming: Geol. Soc. America Bull., v. 80, no. 1, p. 57–82, illus., tables, geol. map, 1969.

The Laramie batholith is an extremely uniform calc-alkaline granitic mass with an exposed area of 2000 km^2. There are gradational contacts with metamorphic terranes on the north and southeast sides. Anorthosite and related syenites intrude the southern terrain. Data from whole rock and trace-element analyses of 87 granitic rocks and 33 gneisses and migmatites are used to describe the petrology and geochemistry of the area. The batholith may have originated by fractional

crystallization of a magma derived by partial melting of the lower crust or upper mantle.—AG

05572 **Conley, James F.; Toewe, E. Clayton.** Geology of the Martinsville West quadrangle, Virginia: Virginia Div. Mineral Resources Rept. Inv. 16, 44 p., illus., table, geol. map, 1968.

This quadrangle in Henry County is underlain by Cambrian or Precambrian age sillimanite–mica schist, interbedded quartzite, biotite gneiss, and amphibolite, converted into granite gneiss, and invaded by small ultramafic dikes altered to tremolite–talc schists. In possibly late Paleozoic time the Leatherwood granite was emplaced, to be subsequently intruded by Rich Acres Norite later cut by numerous feldspar–quartz pegmatites. Late Triassic diabase dikes followed zones of fracture. The nose and east limb of a NE–plunging syncline is outlined by skialithic remnants of metasedimentary rocks and foliations preserved in the paragneisses. Of the crushed stone, sand and gravel, mica, and magnetite that have been produced here, only the first is in current production. Possible resources are feldspar, kaolin, emery, soapstone, sillimanite, quartz, clay, gem stones, and vermiculite.—*from* Authors' abstract

Cook, D. R. *See* Shepard, W. M. 05485

05570 **Couch, Elton L.; Grim, Ralph E.** Boron fixation by illites [with French, German, and Russian abs.]: Clays and Clay Minerals, v. 16, no. 3, p. 249–256, illus., tables, 1968.

The controversial mechanism of boron uptake by illitic clays and the factors controlling such uptake have been studied by treating three illites in solutions containing boron. Boron concentration, salinity, temperature, and time were varied independently over rather wide ranges; irreversible uptake of boron was increased by increasing each of these. The amount of boron fixed also varied with the type of illite. The amount of fixation was controlled primarily by the specific surface area of the clay and also by crystallinity, K–content and/or amount of mixed–layer material, and apparently was independent of original boron content of the clay. A two–step mechanism is proposed for boron fixation by illite, consisting of rapid chemical absorption of the tetrahedral $B(OH)_4$–anion at the frayed edge of the illite flake followed by much slower diffusion of boron into the tetrahedral part of the structure.—*from* Editor's abstract

05433 **Cowan, W. R.** Ribbed moraine—Till–fabric analysis and origin: Canadian Jour. Earth Sci., v. 5, no. 5, p. 1145–1159, illus., tables, 1968.

The origin of a glacier–molded drift landform known as ribbed moraine and its relation to fluted ground moraine and eskers was studied by till–fabric analysis. Proximal fabrics indicate some up–glacier imbrication into the slopes, while distal fabrics are slope conformable. Fabrics from curved ridges as well as from the ribbed moraine–fluted ground moraine junctures appear to have directional components additional to that of regional glaciation. Recurrent ridges of ribbed moraine transverse to the direction of regional glaciation resulted from reactivation of a retreating ice front which bulldozed and piled up proglacial debris which was finally overridden. Adjacent and sometimes superposed flutings are attributed to changes in flow patterns within the ice during and after overriding. Periodicity of the ribbed moraine is not time significant and is believed to be related to thickness of ice and quantity of proglacial debris.—*from* Author's abstract

05240 **Cox, Herbert H.** Definition of ore and classification of ore reserves, *in* Ore reserve estimation and grade control—Canadian Centennial Conf., Quebec, 1967: Canadian Inst. Mining and Metallurgy Spec. Vol. 9, p. 1–2, 1968.

Replies to a questionnaire sent to Canadian mining companies show that some differences of opinion still exist about the meaning of the word "ore" and about the classification and naming of classes of ore. The following definition would likely be accepted by the majority of those consulted—Ore is a natural aggregate of one or more minerals which may be mined and sold at a profit or from which some part may be profitably extracted. The three–fold classification and the definitions

proposed by the United States Bureau of Mines and the United States Geological Survey are acceptable to more than 60 percent of those consulted, but the names preferred for the three classes are Proved, Probable and Possible. Possible Ore should never be included in "Ore Reserves."—Author's abstract

05357 **Cox, Manning W.** Van Stone mine area (lead-zinc), Stevens County, Washington, *in* Ore deposits of the United States, 1933–1967 (Graton-Sales Volume), V. 2: New York, Am. Inst. Mining, Metall. and Petroleum Engineers, p. 1511–1519, illus., table, 1968.

Principal ore deposits occur in highly deformed carbonate rocks of Cambrian age—the Maitlen (Laib) and Metaline Formations. The mine occurs along a steeply dipping S-shaped fold between the Kaniksu batholith and the Rogers Mountain fault. Faults cut across the fold and contain irregular lamprophyric, diabasic, and pebble dikes. The host rocks, dolomites, are decolorized, silicified, and silicated in the mine area. Jasperoid and tremolite are common alteration minerals. The ore minerals are galena, jamesonite, and sphalerite. Ore minerals occur in bunches and pods intergrown with tremolite and jasperoid. Zinc is roughly eight times more abundant than lead. Oxidation ranges to several hundred feet in depth and may be closely related to preglacial ground-water circulation.—*from* Author's abstract

05286 **Crawford, C. B.** Shear strength of soft clay—Sess. 1, Panel discussion, *in* Geotechnical conference on shear strength properties of natural soils and rocks, Oslo, 1967, Proc., V. 2: Oslo, Norwegian Geotechnical Inst., p. 110–112, 118, illus., 1968.

Two case records illustrate the magnitude of settlements under earth fill in a highly sensitive clay in eastern Canada. In one the undrained shear strength of the natural soil under the fill did not increase with time, contrary to expectation. This led to the conclusion that the loss in strength by breaking of bonds due to microstrains in the soil more than compensates for the strength gained due to consolidation; pore pressures responded immediately to the load, from which it is deduced that simultaneously with hydrodynamic dissipation there is a mechanism creating pore pressures. The vane test, reliable for estimation of undrained shear strength of this soil, is not a bad method for the softer clays. The nature of this eastern Canadian clay is demonstrated in four illustrations.—GDC

05416 **Crawford, Johnson; Hoagland, Alan D.** The Mascot-Jefferson City zinc district, Tennessee, *in* Ore deposits of the United States, 1933–1967 (Graton-Sales Volume), V. 1: New York, Am. Inst. Mining, Metall. and Petroleum Engineers, p. 242–256, illus., 1968.

The ore is strata bound, occurring essentially within a stratigraphic range of 200 feet in the Lower Ordovician lower Kingsport and upper Longview Formations. In the lower strata, the ore generally is found in coarsely crystalline clastic dolomite breccia containing silica and chert debris within aphanitic limestones. The upper strata of the mineralized section are fine-grained primary dolomites that, in the ore zones, have been fragmented in mosaic patterns by solution collapse with the interfragmental space filled by white gangue dolomite and sphalerite. Sphalerite is the only important sulfide. The principal ore-controlling structures are rubble breccia zones that are Ordovician in age. The major Appalachian orogenic structures are post-ore and have been superimposed upon the ore bodies.—*from* Authors' abstract

05258 **Creer, K. M.** Paleoshiroty kontinentov v devone po dannym yestestvennoy ostatochnoy namagnichennosti gornykh porod, *in* Problemy paleoklimatologii, trudy simpoziuma: Moscow, Izdatel'stvo "Mir," p. 170–183, illus., tables, 1968; originally published in English, 1964.

This is a Russian translation of a paper presented at the NATO Paleoclimates Conference held in Newcastle-upon-Tyne and Durham, England, on January 7–12, 1963.—DBV

05733 **Crowley, Francis A.; Ossing, Henry A.** Portable seismic array system: U.S. Air Force Cambridge Research Labs. Instrumentation Paper 145 (AFCRL-68-0398), 13 p., illus., 1968.

A 21-element portable seismic array system developed to measure the spatial and temporal characteristics of seismic waves is characterized by ruggedness, flexibility of aperture and channel response, transportability, minimal manpower requirements, operational simplicity, unattended operation, and ability to withstand climatic extremes. The system performance relates to the local environment by delineating signal and noise coherency loss. These qualities are advantageous for monitoring earth motions affecting the performance of motion-sensitive instrumentation, for relating the seismic wave field to geology in teleseismic detection problems, for discriminating between manufactured sources in areas of seismic surveillance, and for subsurface crustal mapping of hardened site areas.—Authors' abstract

05417 **Crump, Robert M.; Beutner, Edward L.** The Benson Mines iron ore deposit, Saint Lawrence County, New York, *in* Ore deposits of the United States, 1933-1967 (Graton-Sales Volume), V. 1: New York, Am. Inst. Mining, Metall. and Petroleum Engineers, p. 49-71, illus., tables, 1968.

The ore is a low-grade replacement deposit within the Grenville gneisses of the Adirondack Mountains. Magnetite and hematite are disseminated throughout the gneisses as discrete grains about 1 mm in size. Both ores are beneficiated by magnetic means. The gneisses are described and named according to the distinctive mineralogy of each. The structure is a northward-plunging syncline overturned to the west. A large subsidiary anticline-syncline complex occurs on the east limb of the major syncline. Iron minerals in ore quantities are confined to areas where the footwall rock has been overturned to become the hanging wall.—*from* Authors' abstract

05365 **Cumberlidge, John T.; Chace, Frederic M.** Geology of the Nickel Mountain mine, Riddle, Oregon, *in* Ore deposits of the United States, 1933-1967 (Graton-Sales Volume), V. 2: New York, Am. Inst. Mining, Metall. and Petroleum Engineers, p. 1650-1672, illus., tables, 1968.

The principal nickel mineral, garnierite, occurs in saprolite which constitutes the bulk of the ore and was probably derived from peridotite and dunite through downward percolating ground waters. Decomposition took place by a net loss of MgO, SiO_2, and Fe without a change in volume. Garnierite-chalcedony boxwork ore was deposited by meteoritic ground water along faults, joints, and at the level of former water tables. Boxwork ore is supergene, the chemicals having been derived from higher in the soil profile. The present deposits are probably truncated remnants of a formerly thicker and much more extensive deposit which probably included laterite at the surface, and probably started to form during a warm interval in early Tertiary.—*from* Authors' abstract

Cumming, G. L. *See* Robertson, D. K. 05431

05314 **Dadson, A. S.** Ore estimates and specific gravity, *in* Ore reserve estimation and grade control—Canadian Centennial Conf., Quebec, 1967: Canadian Inst. Mining and Metallurgy Spec. Vol. 9, p. 3-4, illus., table, 1968.

Common practice in dealing with metalliferous deposits is to cut samples and record them in linear measure. Assays are reported as percent by weight for base metals and as ounces per ton for precious metals. Assay results are applied to the linear sample measures, and then to areas, volumes and tons of ore. The cubic-feet-per-ton factor is generally calculated from an average specific gravity estimate. However, the specific gravity varies from block to block of ore and from sample to sample. For certain types of ore deposits, specific gravity determinations on individual samples are required if there is to be any claim to accuracy in the interpretation of sampling results.—Author's abstract

05322 **Dadson, A. S.; Emery, D. J.** Ore estimation and grade control at the Giant Yellowknife mine, *in* Ore reserve estimation and grade control—Canadian

Centennial Conf., Quebec, 1967: Canadian Inst. Mining and Metallurgy Spec. Vol. 9, p. 215–226, illus., tables, 1968.

Orebodies of the Giant Yellowknife mine [Northwest Territories], which occur as irregular masses, lenses and veins within a complex zone of chlorite and sericite schist, are extremely diverse in size, shape, and attitude; to the end of 1966, they provided about 5,400,000 tons of ore, averaging 0.75 oz of gold per ton. Estimates are based on interpretation of diamond drill cores, those for any given ore shoot being approximations only, revised each year in the light of stoping experience. Accepted classifications of reserves do not apply; they have been reported as Estimate of Developed Ore, available ore outlined in enough detail for stope layouts. Grade control is a difficult and important function of the Geology Dept. Stope geologists are depended upon to mark ore–waste boundaries and guide breaking. On the whole, initial estimates have been too high.—*from* Authors' abstract

05309 **Dagenais, J. E.; Dunn, W. J.; Hamilton, C. G.; Selleck, D. J.; Taylor, R.** Ore reserve estimation and grade control at the Iron Ore Company of Canada, *in* Ore reserve estimation and grade control—Canadian Centennial Conf., Quebec, 1967: Canadian Inst. Mining and Metallurgy Spec. Vol. 9, p. 287–301, illus., tables, 1968.

Two mining complexes—the Knob Lake Division in Quebec and the Carol Division in Labrador—operate in the Labrador trough. At Knob Lake, ores are mixtures of hematite and martite, with goethite, limonite, and manganese oxides and hydroxides, within leached iron-formation in mostly synform structures. Composition varies widely, requiring a high degree of selective mining and grade control. Data from mapping, trenching, and drilling are plotted on vertical cross sections, and reserves measured by planimetering areas of each ore type on the sections. In the Carol area, ores are metamorphic equivalents of unaltered iron-formation farther north. Iron minerals are specular hematite and magnetite, and ores are coarser grained, lower grade, and more uniform than Knob Lake ores. Reserves are calculated from geologic sections; grading is by computers in both areas.—*from* Authors' abstract

Dahl, Gardar G., Jr. *See* Matson, Robert E. 05660

05859 **Dahlen, F. A.** The normal modes of a rotating, elliptical Earth: Royal Astron. Soc. Geophys. Jour., v. 16, no. 4, p. 329–367, illus., tables, 1968.

It is possible to calculate precisely the theoretical eigen-frequencies of any Earth model which is non-rotating, spherically symmetric, and which has an isotropic static stress field and an isotropic dynamic stress-strain relation. In this paper Rayleigh's principle is used to provide a formalism which allows the approximate computation of the normal mode eigen-frequencies of any Earth model which is slowly rotating and slightly aspherical and anisotropic. This formalism is used to compute, correct to second order, the effects of the Earth's ellipticity of figure on the normal mode eigen-frequencies. The results may be used to make a preliminary correction for rotation and ellipticity to the Earth's raw normal mode data.—*from* Author's abstract

05576 **Dahlgren, E. G.** Discovery of a giant, the Oklahoma City Oil Field: Shale Shaker, v. 19, no. 3, p. 53–55, 1968.

Indian Territory Illuminating Oil Company No. 1 Oklahoma City, the 6,000 bbl of oil per day discovery well of 1928, culminated a 24 year exploration effort to find oil in Oklahoma County. Early efforts, geologists involved, and history of its discovery are reviewed upon the occasion of its 40th birthday. In this period the Oklahoma City Field produced a total of 733,543,000 bbl of oil; as of July 1967, a total of 441 wells were producing a daily average of 5,301 bbl. A remaining reserve of over 38 million bbl is indicated.—GDC

05515 **Darling, Richard Graydon.** The distribution of fluorine and other elements in quartz monzonite near ore, Pine Creek contact-metasomatic tungsten deposits, Inyo County, California [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 29, no. 5, p. 1728B, 1968.

05574 **Darnell, Richard D.** Status of the O.C.G.S. [Oklahoma City Geological Society] geologist: Shale Shaker, v. 19, no. 2, p. 22–37, illus., 1968.

A survey for professional affiliations of its 758 members was taken in June 1968 by the Oklahoma City Geological Society. Of the 360 replies, outside of oil companies and consultants, only 8 percent are from service companies, education, and government; in all, 35 percent have an advanced degree. Median age of 43 is shared by the oil companies, consultants are slightly older; median experience is 18 years, only 12 percent indicating less than 12 years. The median 1967 income was 15,000 dollars; ranges of salary are broken down by groups, in relation to job classification, length of experience, education, and starting salaries. Discussion of inequities, supply and demand, includes comments made in reply to special questionnaires sent to industries and universities. Educators and management are more optimistic about geologists' future opportunities than are the working geologists.—GDC

00045 **Dasch, E. Julius.** Strontium isotope disequilibrium in a porphyritic alkali basalt and its bearing on magmatic processes: Jour. Geophys. Research, v. 74, no. 2, p. 560–565, tables, 1969.

Partly resorbed, strontium-rich phenocrysts of feldspar, apatite, kaersutite, and biotite in a 19 m.y.-old basaltic dike rock from Trans-Pecos, Texas, have initial Sr-87/Sr-86 ratios of about 0.7026. Untreated and acid-leached samples of the groundmass, which is alkalic and strontium rich, have initial Sr-87/Sr-86 ratios of about 0.7041. The magma from which the large phenocrysts grew evidently became contaminated with radiogenic strontium during the process of emplacement. Although the temperature of the assemblage must have been about 1000°C at time of intrusion, the magma cooled before the strontium in the phenocrysts and in the matrix could equilibrate isotopically. The results show that analyses of both groundmass and phenocrysts of some volcanic and hypabyssal igneous rocks can yield a more complete magmatic history for the rocks than whole-sample analyses alone.—Author's abstract

05222 **David, M.; Blais, R. A.** Discussion on "Practical aspects of computer methods in ore reserve analysis" [by D. T. O'Brian and A. Weiss, 1968], *in* Ore reserve estimation and grade control—Canadian Centennial Conf., Quebec, 1967: Canadian Inst. Mining and Metallurgy Spec. Vol. 9, p. 114–115, illus., 1968.

This discussion of O'Brian and Weiss' paper (ibid., p. 109–113) emphasizes the practical aspects of interpolation procedures in sample weighting, and outlines, by means of examples, some of the inherent difficulties. The value of computerization of data depends upon the value of the data.—ESL

Davis, John C. *See* Wahlstedt, Warren C. 05661

Davis, L. A. *See* Gordon, R. B. 00017

05339 **Dean, A. W.; Mann, E. L.** The evaluation of chrysotile asbestos deposits, *in* Ore reserve estimation and grade control—Canadian Centennial Conf., Quebec, 1967: Canadian Inst. Mining and Metallurgy Spec. Vol. 9, p. 281–286, illus., table, 1968.

Evaluation of an asbestos discovery presents many unique problems: because ore and gangue have the same composition, chemical assays are useless; evaluation is dependent not only on amount of fiber present, but also on its length and other characteristics. The geology of chrysotile asbestos and its exploration are reviewed briefly. A comprehensive evaluation is possible only by means of diamond drilling; core evaluation and logging are discussed and the visual evaluation method is described in detail. Rock value contour plans are used effectively for long-range open pit grade control.—ESL

00044 **Decker, E. R.** Heat flow in Colorado and New Mexico: Jour. Geophys. Research, v. 74, no. 2, p. 550–559, illus., tables, 1969.

Nine new values of heat flow in Colorado and New Mexico range from 1.22 μ cal per sq cm sec to 2.7 μ cal per sq cm sec. These data indicate that high heat flow is characteristic of all the Southern Rocky Mountains and the Basin and Range province in southwestern New Mexico. In the Southern Rocky Mountains, high and variable heat flow may be due to radioactivity in the upper part of a thick crust. In the Basin and Range province, differences in crustal structure suggest that high flux may be related to additional factors besides crustal radioactivity.—Author's abstract

deCook, K. J. *See* Wilson, L. G. 05559

05600 **deLaguna, Wallace.** Importance of deep permeable disposal formations in location of a large nuclear-fuel reprocessing plant, *in* Subsurface disposal in geologic basins—A study of reservoir strata: Am. Assoc. Petroleum Geologists Mem. 10, p. 21–31, tables, 1968.

The most important disposal problem is that of low-level waste; disposal into deep permeable formations seems to offer the best possibilities. The most favorable method for disposal of medium-level waste is into hydraulically fractured shale. Suitable shale generally is found in basin areas also suitable for low-level waste disposal. A favored method for disposal of high-level waste is storage in solid form in mined cavities in salt; thus the selection of a site that also has salt beds is advantageous. As more information is gained about maximum permissible concentrations of radioactive nuclides, it may alter the requirements for a plant site. Disposal of radioactive wastes into deep permeable formations is now practicable only for low-level waste, but it holds potential for certain medium- and high-level wastes, and also of such gaseous wastes as krypton-85.—*from* Author's abstract

05708 **DeMar, Robert.** The Permian labyrinthodont amphibian *Dissorophus multicinctus*, and adaptations and phylogeny of the family Dissorophidae: Jour. Paleontology, v. 42, no. 5, p. 1210–1242, illus., 1968.

Dissorophus multicinctus Cope is a labyrinthodont from north-central Texas. The armor (dermal ossifications above vertebral column), sacral region, cervical region, skull, general morphology and preservation all suggest that the animal was relatively terrestrial for a Permian amphibian. A hypothesis based on degree of ossification, kinds of coexisting species, and manner of preservation, that allows the degree of terrestrial adaptation of Permian tetrapods to be compared, suggests that the Dissorophidae evolved ever increasing terrestrial adaptation and that the armor evolved, at least twice within the family, as one response to demands of the new environment. The most important function of the armor was to strengthen the vertebral column.—*from* Author's abstract

05729 **Dennison, John M.** Analysis of geologic structures: New York, W. W. Norton and Co., 209 p., illus., 1968.

This material, prepared chiefly as a laboratory workbook for undergraduate students in structural geology, can also be used in connection with geologic field work and as an introduction to specialized techniques for graduate and professional levels of work. Fundamental ideas are in the first seven chapters (true and apparent dips, structure sections, thickness determinations, depth to dipping strata, outcrop patterns and three-point problems, structure contours and isopachs, and interpretation of geologic maps), followed by advanced topics (oriented structures, faults, dip determination from drill cores, stereographic projection, and palinspastic maps) that can be used selectively. The approach is to concentrate on developing reasoning power concerning the geometry of rocks in nature, with emphasis on the trigonometric method, while using a minimum of descriptive terminology.—MCM

05561 **Denson, Keith H.; Shindala, Adnan; Fenn, Charles D.** Permeability of sand with dispersed clay particles: Water Resources Research, v. 4, no. 6, p. 1275–1276, illus., tables, 1968.

Montmorillonite clays in amounts above three percent by weight may be expected to reduce effective permeability of pure sands to fresh water by 100 percent or to practically zero for sands with the grain size distribution with mean of 0.30 mm and standard deviation of 0.18 mm. Kaolinite clays in amounts above 16 percent by weight may be expected to reduce the permeability of similar sands to practically zero.—Authors' abstract

05281 **Dickson, Frank W.; Tunell, George.** Mercury and antimony deposits associated with active hot springs in the western United States, *in* Ore deposits of the United States, 1933–1967 (Graton–Sales Volume), V. 2: New York, Am. Inst. Mining, Metall. and Petroleum Engineers, p. 1673–1701, illus., tables, 1968.

Five hot-spring areas show evidence of present day deposition of HgS, and two also show Sb_2S_3 deposition. Waters of Amedee Springs, Lassen County, and Coso springs, Inyo County, Calif., and Boiling springs, Valley County, Idaho, deposit HgS only; Steamboat springs, Washoe County, Nev., waters deposit mainly stibnite and silica and recently, HgS; Sulphur Bank waters, Lake County, Calif., deposit mostly stibnite and some HgS; hot-spring waters of all the springs represent highly modified deep water. HgS is transported in moderately alkaline sulfide solutions as HgS_2. Fluctuating deposition of stibnite and cinnabar reflects availability of sulfide or variations in deep-source HgS and Sb_2S_3. Silica and HgS dissolve mutually in alkaline sulfide solutions, and cinnabar and quartz would be expected to deposit simultaneously.—*from* Authors' abstract

Dill, David B., Jr. *See* Lea, Edgar R. 05383

Dingess, Paul R. *See* Brockie, Douglas C. 05407

05272 **Dinkins, Theo H., Jr.** Jurassic stratigraphy of central and southern Mississippi, *in* Jurassic stratigraphy of Mississippi: Mississippi Geol., Econ. and Topog. Survey Bull. 109, p. 9–37, illus., 1968.

The stratigraphic column in this report includes strata from the Eagle Mills Formation of Triassic age to the Schuler Formation of Jurassic age. Lateral variations, facies changes and the time-transgressive nature of lithologic boundaries result in a multiplicity of lithologically based correlations. Stratigraphic cross sections give some idea of the writer's concept. From their known lithologies, the Eagle Mills, Werner, Louann and Norphlet sediments may never be seriously considered as deep exploration objectives; however, favorable source facies to reservoir facies relationships are present throughout the Smackover, Haynesville and Cotton Valley sediments. Structural effects related to salt uplift have controlled the accumulation of vast quantities of hydrocarbons.—*from* Author's abstract

05527 **Dodds, C. J.** A study of garnets and host rocks from the central Kootenay Lake area, southeastern British Columbia [abs.]: Bull. Canadian Petroleum Geology, v. 16, no. 3, p. 417, 1968.

Donaldson, Alan. *See* Milner, William. 05577

Donaldson, Alan C. *See* Thomas, Lloyd R. 05580

Donohue, P. C. *See* Bither, T. A. 05487

05230 **Downey, Joe S.** Late Pliocene lagomorphs of the San Pedro Valley, Arizona, *in* Geological Survey research 1968, Chap. D: U.S. Geol. Survey Prof. Paper 600-D, p. D169–D173, illus., table, 1968.

The Benson local fauna from the San Pedro valley of Arizona contains fossil rabbit material assignable to the genera *Hypolagus, Notolagus, Nekrolagus?*, and a new genus, *Aluralagus* which appears to be related to the genus *Pratilepus* from the Pliocene Rexroad fauna of Kansas. *Sylvilagus? bensonensis* Gazin is reassigned to the new genus *Aluralagus*. A late Pliocene age is suggested for the Benson local fauna —Author's abstract

05241 **Downs, George R.; Henderson, Bonnie C.** Student enrollment in earth science, 1967–68: Geotimes, v. 13, no. 9, p. 20–21, illus., table, 1968.

Employment opportunities in 1968 for geoscience graduates at all levels are excellent. Returns from 346 institutions in the United States and 24 in Canada reporting enrollment for the 1967–68 school year are tabulated. Three graphs show enrollment of geoscience degree candidates in the United States. The graph for senior majors reflects hiring rates, with a marked decline in 1961–64 and a steady climb in the last two years; at the master's level, an increase of 375 percent since 1965–66 can be seen; and the total number of PhDs in geoscience has increased steadily. In addition, 123,674 nonmajors are taking geoscience courses.—ESL

05229 **Doyle, Roger W.** The origin of the ferrous ion–ferric oxide Nernst potential in environments containing dissolved ferrous iron: Am. Jour. Sci., v. 266, no. 9, p. 840–859, illus., 1968.

Experiments in iron-rich interstitial water taken from sediment of Linsley Pond, Connecticut have shown that a potential-determining reaction exists for platinum electrodes which do not carry a deposit of ferric oxide (as is generally required in experiments of this type). The stable redox potentials were more negative than predicted by the equation $Eh = 0.965 - 0.177pH - 0.059 \log a_{Fe^{++}}$ by about 100 mv. The oxide layer on the electrode, where present, disappeared slowly in this water as its potential drifted down from an initial value close to the ferrous ion–ferric oxide Nernst potential. Current–potential curves revealed several electroactive substances, none of which could be positively identified with Fe^{++} ion.—*from* Author's abstract

05337 **Doyle, Roger W.** Identification and solubility of iron sulfide in anaerobic lake sediment: Am. Jour. Sci., v. 266, no. 10, p. 980–994, illus., table, 1968.

The iron sulfide that darkens the color of some anaerobic sediment has been tentatively identified as mackinawite (tetragonal FeS) in sediment from Linsley Pond, Conn. The mineral was identified by suspending sediment in solutions saturated with H_2S at one atm pressure and determining the equilibrium ion activity product (equilibrium IAP) of the reaction: $FeS = Fe^{++} + S^{--}$. The IAP was $10^{-17.7}$ compared to published values of $10^{-17.6}$ for synthetic mackinawite. These values can be assumed to approximate the 'solubility product' of FeS in environments such as the hypolimnia of Linsley Pond and Lake Mendota. Since griegite has been shown to be stable relative to mackinawite in marine sediment, this mineral may be useful in differentiating Fe^{++}–rich and H_2S–rich environments in the fossil record.—*from* Author's abstract

Dracup, John A. *See* Hall, Warren A. 05488

05259 **Drew, Charles M.; Tschudy, Bernadine B.** *Aquilapollenites*—Fossil pollen as seen under the scanning electron microscope: Geol. Soc. America Bull., v. 79, no. 12, p. 1829–1832, illus., 1968.

Photographs of a Late Cretaceous species of *Aquilapollenites* illustrate the usefulness of the scanning electron microscope (SEM) for the study of fossil pollen. The SEM has the advantages of great depth of focus and wide range of magnification; using present techniques, its use for the study of unsectioned specimens is limited to the observation of surface detail.—Authors' abstract

05362 **Dubois, Robert L.; Brummett, Richard W.** Geology of the Eagle Mountain mine area, *in* Ore deposits of the United States, 1933–1967 (Graton-Sales Volume), V. 2: New York, Am. Inst. Mining, Metall. and Petroleum Engineers, p. 1592–1606, illus., table, 1968.

The iron deposits of this mine, in Riverside County, California, are in two well-defined horizons in a metasedimentary series, only along the north limb of a major anticline. Host rocks for the ores were limestones and dolomites with associated quartzites. Magnetite plus pyrite comprised the primary mineralization that formed replacement lenses and stringers. The primary ore has been oxidized at higher elevations of the deposits. Hydrothermal alteration formed actinolite–tremolite

granofels, local phlogopite, and minor tourmaline in the ore zones. The alteration and the ore deposition seem related to the same magmatic event that formed the porphyritic quartz monzonite intrusion of the area.—*from* Authors' abstract

Duffell, Stanley. *See* Roach, R. A. 05663

Dunn, W. J. *See* Dagenais, J. E. 05309

05413 **Dutton, Carl E.; Zimmert, Paul W.** Iron ore deposits of the Menominee district, Michigan, *in* Ore deposits of the United States, 1933–1967 (Graton-Sales Volume), V. 1: New York, Am. Inst. Mining, Metall. and Petroleum Engineers, p. 538–549, illus., tables, 1968.

Two Middle Precambrian formations in the Menominee district contain iron. The older, in the northeastern part of the district, is composed mainly of hematite, magnetite, quartz, and minor silicates and contains about 34 percent iron. Metamorphism has coarsened the grains so that mechanical beneficiation up to 60 percent iron is possible. The older formation is less metamorphosed in the southern part of the area. The younger formation occurs in the west and, if unaltered, is interlayered siderite and chert. The ore contains more than 50 percent iron, and formed as local residual concentrate in two stages. The siderite was converted to iron oxide and the silica was contemporaneously or subsequently leached or replaced; a combination of these processes is possible.—*from* Authors' abstract

05342 **Dyck, Willy; Smith, A. Y.** Use of radon-222 in surface waters in geochemical prospecting for uranium: Mining in Canada, May 1968, p. 27–28, 1968.

As part of a test for use of this low-cost simple method in preliminary reconnaissance, 59 samples of surface waters were collected in the Bancroft area, Ontario, and 78 samples in the Ottawa–Hull and surrounding areas, 30 of them from the southern Gatineau Hills where uranium mineralization is known. Radon analyses were made by degassing the waters and measuring alpha activity of the gas in a ZnS cell, and uranium content of the waters was measured by a fluorometric technique. The radon in surface waters varied from 0 to 2200 pc/l, and uranium from 0 to 47 ppb. A higher radon (but not uranium) content in creeks and streams than in lakes and ponds was probably due to proximity to bedrock. Although no clear correlation between radon and uranium values in the waters was observed, the higher values indicated gross correlation with uraniferous areas.—GDC

Eade, K. E. *See* Fahrig, W. F. 05447

05614 **Eargle, D. Hoye.** Developing a strategic mineral resource—Uranium in Texas, *in* Internat. Oil Scouts Assoc., 45th Ann. Mtg., San Antonio, Tex., 1968: Austin, Tex., Internat. Oil Scouts Assoc., p. 31–36, illus., 1968.

Petroleum companies are rapidly entering the fields of uranium industry. The first uranium was found in fracture-controlled veins cutting igneous and metamorphic rocks; during the 1948–58 rush, the greater amounts were produced from sandstones, with the Colorado Plateau the most important source; finally uranium was found on the coastal plain of Texas. The early history of uranium, its development, and the story of its discovery in the coastal plain are reviewed. Mining of both shallow and deep ores is described. Most of the land now being explored is along the trend of upper Eocene to Pliocene rocks, and around the Triassic outcrop near the base of the High Plains caprock. Current exploration is by boring, sampling, and logging.—ESL

05381 **Eastlick, John T.** Geology of the Christmas mine and vicinity, Banner mining district, Arizona, *in* Ore deposits of the United States, 1933–1967 (Graton-Sales Volume), V. 2: New York, Am. Inst. Mining, Metall. and Petroleum Engineers, p. 1191–1210, illus., tables, 1968.

Precambrian, Cambrian, Devonian, Mississippian, Pennsylvanian, and Cretaceous sedimentary and Cretaceous volcanic rocks are deformed and intruded by fine-grained diorite, quartz mica diorite, and dacite porphyry. At least four stages of mineralization are recognized: the first, contact metamorphism; the second,

hydrothermal alteration in which favorable zones were prepared for mineralization; the third, the main deposition of sphalerite, chalcopyrite, bornite, and galena; and the fourth, deposition of minor amounts of sulfides with a late anhydrite and quartz gangue. The ore is in veins, veinlets, pipes, irregular massive replacements, and bedded replacements. The deposits are mesothermal, occurring as normal metasomatic replacement and vein types.—*from* Author's abstract

Edmonds, C. M. *See* Wanless, R. K. 05265

05604 **Edmund, R. W.; Goebel, Edwin D.** Subsurface waste-disposal potential in Salina basin of Kansas, *in* Subsurface disposal in geologic basins—A study of reservoir strata: Am. Assoc. Petroleum Geologists Mem. 10, p. 154–164, illus., 1968.

Study of the geology of the Salina basin in Kansas shows good potential storage reservoirs for industrial waste in a Cambrian sandstone, in Pennsylvanian shale beds, and in Permian salt beds. The natural flow of fluids in the basin is thought to be from north to south at a slow rate.—Authors' abstract

Edwards, Marc. *See* Fagan, John J. 00015

Eggler, David H. *See* Chronic, John. 00019

05430 **Eidel, J. J.; Frost, J. E.; Clippinger, D. M.** Copper-molybdenum mineralization at Mineral Park, Mohave County, Arizona, *in* Ore deposits of the United States, 1933–1967 (Graton-Sales Volume), V. 2: New York, Am. Inst. Mining, Metall. and Petroleum Engineers, p. 1258–1281, illus., table, 1968.

The quartz-monzonite Ithaca Peak stock intruded the Precambrian Cerbat complex of schist, quartz-feldspar gneiss, and amphibolite, producing a quartz-diorite rim. Following crystallization, the stock and its aureole were fractured, and the stockwork was then mineralized during a period of decreasing temperature by quartz-pyrite-chalcopyrite veinlets, then quartz-pyrite-chalcopyrite veins with distinct selvages and, finally, by pyrite-chalcopyrite-galena-sphalerite veins. The stock was pervasively sericitized or argillized. It is suggested that this quartz-sulfide mineralization, the product of differentiation, may indicate that the later hydrothermal mineralization may also have been the product of differentiation.—*from* Authors' abstract

Emanuelson, J. W. *See* Marsden, R. W. 05412

Emery, D. J. *See* Dadson, A. S. 05322

05405 **Emery, John A.** Geology of the Pea Ridge iron ore body, *in* Ore deposits of the United States, 1933–1967 (Graton-Sales Volume), V. 1: New York, Am. Inst. Mining, Metall. and Petroleum Engineers, p. 359–369, illus., 1968.

The Pea Ridge iron ore deposit near Sullivan, Mo., is a dike-like mass of magnetite enclosed in Precambrian porphyries. The ore body tops at the Precambrian surface 1,300 feet below the present surface and extends to an unknown depth; it dips nearly vertically. Faulting, both pre- and post-ore, is of minor consequence, and no known preferred structural conditions existed prior to the ore emplacement. The ore body is magnetite with specular hematite, quartz, apatite, and pyrite occurring as accessory minerals. Hanging-wall quartz-amphibole and footwall quartz-hematite occur as replacements of certain porphyries. Further alteration has caused sericitization of parts of these zones. The deposit was formed by a single injection of a magmatic differentiate with hydrothermal end phases forming the quartz-amphibole and quartz-hematite portions.—*from* Author's abstract

05502 **Emery, K. O.** Shallow structure of continental shelves and slopes: Southeastern Geology, v. 9, no. 4, p. 173–194, illus., 1968; *in* Mineral resources of the world ocean—Symposium, Newport, R. I., 1968, Proc.: Rhode Island Univ. Graduate School Oceanography Occasional Pub. 4, p. 9–22, illus., 1968.

About 100 continuous seismic reflection profiles have been published of the continental shelves and slopes of the United States, and a smaller number for the

rest of the world. Comparison and classification of the profiles show that most portray a basic seaward growth of the continents followed by faulting or other tectonic alteration, followed by renewed deposition. Deposition is chiefly in the form of strata at their probable angle of rest, but large traps were formed by fault blocks and smaller ones by organic reefs and diapiric dams. Pleistocene glaciation greatly modified the surface of the shelf by erosion and deposition. Subsequent deposition has been too slight to return the surface to its "normal" marine depositional profile.—*from* Author's abstract

00033 **Engdahl, Eric R.; Flinn, Edward A.** Seismic waves reflected from discontinuities within Earth's upper mantle: Science, v. 163, no. 3863, p. 177–179, illus., 1969.

Precursors to normal seismic waves of the PKPPKP type in the distance range of 55° to 75° are ascribed to reflection of this phase from within the Earth's upper mantle. The new observations confirm the existence of a sharply defined transition zone, probably worldwide in extent, at a depth of approximately 650 km. These data are shown to be a useful tool for the study of upper mantle structure on a global basis.—Authors' abstract

Engels, Joan C. *See* Yates, Robert G. 05201

Enos, Paul. *See* Perkins, R. D. 05681

05311 **Ensign, C. O., Jr.; Patrick, J. L.** Ore reserve computation and ore dilution control at the White Pine Mine, White Pine, Michigan, *in* Ore reserve estimation and grade control—Canadian Centennial Conf., Quebec, 1967: Canadian Inst. Mining and Metallurgy Spec. Vol. 9, p. 308–318, illus., table, 1968.

A program of grade control was begun at the White Pine mine on the Keweenaw Peninsula in 1961. The copper orebody occurs in the lowest part of the Precambrian Nonesuch Shale; ore is primarily chalcocite. In the room-and-pillar techniques used, dilution, caused by over- or under-breaking the mine roof and floor, has been reduced from over nine percent to about two percent. Contour maps are the basic tool in ore reserve computation. Isograd and isopach maps for the beds are based on core-drill samples. Values from these are prepared for 1,000-ft blocks. The large amount of data, hundreds of holes, made use of the computer valuable.—*from* Authors' abstract

05409 **Ensign, C. O., Jr.; White, W. S.; Wright, J. C.; Patrick, J. L.; Leone, R. J.; Hathaway, D. J.; Trammell, J. W.; Fritts, J. J.; Wright, T. L.** Copper deposits in the Nonesuch Shale, White Pine, Michigan, *in* Ore deposits of the United States, 1933–1967 (Graton-Sales Volume), V. 1: New York, Am. Inst. Mining, Metall. and Petroleum Engineers, p. 460–488, illus., 1968.

The copper (chalcocite and native) deposit, a large stratiform ore body 4 to 25 feet thick and several miles across, is confined to the basal beds of the Nonesuch Shale. The rocks are unmetamorphosed and only moderately deformed, mainly by tilting and faults. Pyrite, presumably syngenetic, is the only prominent sulfide throughout most of the Nonesuch Shale; the basal beds contain the disseminated copper minerals. The copper minerals within the cupriferous zone are stratigraphically controlled. The main copper mineralization is independent of the structure and apparently antedates the deformation. The copper may have been introduced from the underlying sandstone prior to lithification, although the source of the mineralizing solutions and the copper is unknown.—*from* Authors' abstract

05260 **Etter, Robert J.; Hoyer, Richard P.; Partheniades, Emmanuel; Kennedy, John F.** Depositional behavior of kaolinite in turbulent flow: Am. Soc. Civil Engineers Proc., v. 94, paper 6242, Jour. Hydraulics Div., no. HY6, p. 1439–1452, illus., 1968.

An experimental investigation, utilizing an annular-rotating channel and a counter-rotating ring, of the depositional characteristics of a fine cohesive sediment revealed that after an initial period of rapid deposition, the sediment concentration approaches asymptotically an equilibrium value. The ratio of equilibrium to initial concentration is nearly independent of the latter, and for given sediment properties and water chemistry depends only on the flow conditions. Comparison of size

distributions of the parent material with that retained in suspension when equilibrium was achieved indicated that greatest deposition occurs among clay-size fractions, suggesting that deposition is controlled predominantly by flocculation, and that strength and size of flocs exert a stronger influence on deposition than does initial particle weight.—*from* Authors' abstract

Evans, J. H. *See* Rancourt, G. 05323

05310 **Ewanchuk, H. G.** Grade control at Bethlehem Copper, *in* Ore reserve estimation and grade control—Canadian Centennial Conf., Quebec, 1967: Canadian Inst. Mining and Metallurgy Spec. Vol. 9, p. 302–307, illus., tables, 1968.

Following a brief description of the structure, mineralization and location of the mine area, this paper outlines the methods of "grade control" now being employed at Bethlehem Copper Corporation Ltd. [British Columbia]. The methods of sampling, sub-grade drilling, blasting and outlining the ore, and the actual removal of these outlined blocks, are discussed. The paper concludes with a summary of the results obtained, illustrating the effectiveness of this method of grade control.—Author's abstract

Ewing, M. *See* Nowroozi, A. A. 00002

05549 **Fabbi, B. P.; Volborth, A.** Ultra-soft X-ray fluorescence analysis for oxygen in fifteen igneous rocks: Norelco Reporter, v. 15, nos. 3–4, p. 93–95, illus., table, 1968.

Oxygen is determined by X-ray fluorescence using a demountable ultra-soft X-ray source of the Henke type in conjunction with a multilayered lead stearate decanoate crystal and a flow proportional counter. Counts under the 2θ peak of oxygen in the unknown samples are compared and ratios calculated with respect to counts obtained for U.S. Geological Survey Standard Rock Granite G-1. Pure quartz powder, U.S. Geological Survey Standard Rocks Granite G-1 and Diabase W-1, and a mixture of 50 percent Granite G-1 and 50 percent Diabase W-1 are used to obtain a working calibration curve. Corrections are made for Al_2O_3 and TiO_2. The precision in terms of standard deviation and relative standard deviation obtained by this method of instrumental analysis is S = 0.40 percent and C = 0.86 percent.—Authors' abstract

00015 **Fagan, John J.; Edwards, Marc.** Paleocurrents in Normanskill Formation, south of Hudson and Catskill, New York: Geol. Soc. America Bull., v. 80, no. 1, p. 121–123, illus., 1969.

The Normanskill Formation of Ordovician age includes an upper member, the Austin Glen Member, which is more than 500 feet thick. The Austin Glen Member is well exposed on the eastern shore of the Hudson River and consists of a sequence of shale and graywacke sandstone. The graywacke beds contain abundant sole markings which indicate paleocurrents flowing in various directions. Northeasterly and northwesterly flow were dominant directions, but sole markings indicating currents toward almost all other directions exist. The considerable divergence of paleocurrents suggests a greater complexity of Ordovician paleogeography than is generally assumed.—*from* Authors' abstract

05447 **Fahrig, W. F.; Eade, K. E.** The chemical evolution of the Canadian Shield: Canadian Jour. Earth Sci., v. 5, no. 5, p. 1247–1252, illus., tables, 1968.

Archean surface crystalline rocks of the Canadian Shield differ chemically from those of Proterozoic age; younger rocks are higher in K_2O, TiO_2, U, and Th and lower in Na_2O, Cr,Ni, and possibly MgO and CaO. This may be a secondary result of vertical chemical zoning of the crust by metamorphism accompanied by anatectic melting. Erosion of a zoned crust would result in enrichment of elements such as K,Na,Si,U, and Th in younger sedimentary basins. The crystalline crust subsequently evolved from sediments of these basins would be enriched in these elements relative to older rocks exposed by erosion. Secular chemical evolution of the shield may also reflect a progressive, though irregular, shift in composition of new sial being added to the crust; evidence is found in increase in potassium

of dike swarms that were feeders of new sial to upper part of the crust.—*from* Authors' abstract

Fahrig, W. F. *See* Murthy, G. S. 05469

Farkas, Steven E. *See* Blagbrough, John W. 05211

05516 **Farmer, George Thomas, Jr.** Bifoliate Cryptostomata of the Simpson Group, Arbuckle Mountains, Oklahoma [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 29, no. 5, p. 1728B, 1968.

00016 **Faure, G.; Chaudhuri, S.; Fenton, M. D.** Ages of the Duluth Gabbro complex and of the Endion Sill, Duluth, Minnesota: Jour. Geophys. Research, v. 74, no. 2, p. 720–725, illus., tables, 1969.

This paper reports Rb–Sr whole-rock age determinations made on the Duluth Gabbro and related Endion Sill. Both rock suites form satisfactory isochrons, giving the following dates: Duluth Gabbro, 1,115 ± 14 m.y.; Endion Sill, 1,092 ± 15 m.y. The difference in age is not statistically significant. The initial Sr-87/Sr-86 ratios calculated for both are somewhat higher than would be expected for magma derived exclusively from the upper mantle; some assimilation of crustal rocks is indicated. The Rb–Sr date for the Duluth Gabbro is in perfect agreement with the U–Pb age.—DBV

05610 **Faust, Richard A.; Nimlos, Thomas J.** Soil microorganisms and soil nitrogen of the Montana alpine: Northwest Sci., v. 42, no. 2, p. 101–107, tables, 1968.

The authors have made a broad ecological study of three alpine areas in Montana, and present data on number of bacteria and molds, and amounts of total, nitrate, and ammonium nitrogen in the soils. Surface horizons of the soils contain abundant nitrogen in organic form, but very little as nitrate or ammonium; this is probably due to low activity of microorganisms in alpine soils. It is doubtful that much nitrogen could weather from the rocks from which these soils formed, especially the metamorphosed igneous rocks. The addition of nitrogen which has been converted from N_2 to NO_3 by electrical discharges or other reactions in the ionosphere and washed into the soil by precipitation is a distinct possibility, since the sites are generally on exposed peaks where lightning strikes are common.—MST

05192 **Feininger, Tomas.** The updip termination of a large dike of Westerly Granite and the regional distribution of the Westerly and Narragansett Pier Granites in Rhode Island and Connecticut, *in* Geological Survey research 1968, Chap. D: U.S. Geol. Survey Prof. Paper 600–D, p. D181–D185, illus., table, 1968.

Observations at updip termination of a large Westerly Granite dike in Narragansett Pier Granite, exposed near Westerly, R.I., suggest Westerly magma was initially intruded along a preexisting fracture to the termination site; continued intrusion of magma thickened the dike but did not extend it farther updip. Effects of deformation in the host granite are recrystallization to pegmatite and disharmonious plastic deformation of predike platy flow structure; the fracture followed by the dike was probably a cross joint in the host granite. These observations and no chilled contact for the Westerly are interpreted as direct evidence that Westerly Granite is an aplitic phase of Narragansett Pier. Abundance of dikes of Westerly cutting metamorphic rocks of southeastern Connecticut suggests the Narragansett Pier may extend westward at depth and have batholithic dimensions.—*from* Author's abstract

Fenn, Charles D. *See* Denson, Keith H. 05561

Fenton, M. D. *See* Faure, G. 00016

Ferris, Clinton S., Jr. *See* Chronic, John. 00019

05751 **Finch, Warren I.** Geologic map of the Lovelaceville quadrangle, western Kentucky: U.S. Geol. Survey Geol. Quad. Map GQ–763, scale 1:24,000, section, text, 1968.

Chief resources of the Lovelaceville quadrangle are gravel for road metal from continental deposits (test results are tabulated), ball and refractory clay from Eocene strata in the northern section (slow firing test results are tabulated), and ground water mainly from wells less than 200 feet deep in sands of the Eocene Claiborne Formation. Results of engineering studies made a few miles to the northeast on similar materials indicate slump blocks and landslides are common in the vicinity of the large clay deposits southwest of Lovelaceville and would present engineering problems in road building and clay mining.—MCM

Fischbuch, N. R. *See* Leavitt, E. M. 05525

05389 **Fischer, R. P.** The uranium and vanadium deposits of the Colorado Plateau region, *in* Ore deposits of the United States, 1933–1967 (Graton–Sales Volume), V. 1: New York, Am. Inst. Mining, Metall. and Petroleum Engineers, p. 735–746, illus., tables, 1968.

Most of the deposits occur in streamlaid lenses of sandstone in the Chinle and Morrison Formations. The ore minerals below the zone of oxidation are low-valent oxides and silicates of uranium and vanadium; all of these, except the vanadium silicates, oxidize readily. The ore partly replaces fossil wood but mostly impregnates sandstone, typically forming tabular ore bodies that are nearly concordant to the bedding of the host rock. The deposits are epigenetic, but the source of the ore metals, the nature of the ore-bearing solutions, and the time of ore emplacement are uncertain. A few uranium deposits are disconcordant, occurring in collapsed breccia pipes or along linear fractures.—*from* Author's abstract

05361 **Fisk, Elwin L.** Cordero mine, Opalite mining district, *in* Ore deposits of the United States, 1933–1967 (Graton–Sales Volume), V. 2: New York, Am. Inst. Mining, Metall. and Petroleum Engineers, p. 1573–1591, illus., tables, 1968.

The Cordero mine is in Humboldt County, Nevada, near the Oregon border. Nearly all of the mercury ore has been found in Miocene rhyolitic intrusives, flows, tuffs, and lake beds. These rhyolites have been argillically altered at depth and extensively silicified at or near the surface. Most of the ore at Cordero is related to two nearly-vertical faults. The mineralization may be genetically related in some way to the footwall rhyolite intrusive. The control of the cinnabar mineralization in the large rectangular pipe of ore along M-fault is accomplished by numerous slips or minor faults in the Cordero rhyolite. The top of the main zone is 250 feet below the surface and the bottom is about 750 feet below the surface.—*from* Author's abstract

00012 **Fiske, Richard S.** Recognition and significance of pumice in marine pyroclastic rocks: Geol. Soc. America Bull., v. 80, no. 1, p. 1–8, illus., table, 1969.

Pumice is abundant in many ancient sequences of marine pyroclastic rocks and is evidence that contemporaneous or nearly contemporaneous volcanic activity was the source of at least some of the fragmental debris. The pumice in many such sequences of rock, however, is easily overlooked. Pumice-rich rocks commonly occur toward the top of thick vertically graded beds of lapilli tuff and tuff breccia. Hand-lens examination of wetted specimens in the field will usually reveal the wispy and ragged outlines of some of the pumice that is present. More detail can be seen in thick sections and in conventional thin sections of pumice rock.—*from* Author's abstract

05182 **Fitzpatrick, G. L.; King, N. J.** Field procedure for measuring settling characteristics of sediment samples, *in* Geological Survey research 1968, Chap. D: U.S. Geol. Survey Prof. Paper 600-D, p. D87–D94, illus., 1968.

In conjunction with morphologic studies of ephemeral stream channels, a simple field procedure requiring less than 20 minutes per sample has been developed for measuring the settling characteristics of selected sediment samples. Results are depicted graphically as sediment settling curves by plotting accumulated volume of sediment versus time. Parameters defining the settling characteristics of each sample tested are obtained by graphical solution of an equation fitting the settling curves. The form of this equation was obtained by comparing the sediment-water system with an analogous electrical system. Trial application of the procedure to selected

samples from ephemeral stream deposits indicates that the values of the parameters thus obtained may provide an indirect method for determining flow conditions during the time of deposition.—Authors' abstract

05480 **Fleet, M. E.** The superstructures of two synthetic pyrrhotites: Canadian Jour. Earth Sci., v. 5, no. 5, p. 1183–1185, illus., 1968.

A new hexagonal superstructure of pyrrhotite, with a = 2A, c = 3C (where A and C are respectively the a and c parameters of the NiAs-type sub-cell), is reported from a quenched, synthetic iron sulfide preparation containing pyrrhotite in equilibrium with pyrite. The X-ray diffraction record for it is similar to those for previously reported analogous superstructures, but exhibits reflections in positions equivalent to positions of extinction in the latter. In addition, a hexagonal superstructure with a = 2A, c = 4C is reported from a less-sulfur-rich, quenched, synthetic pyrrhotite.—Author's abstract

Flinn, Edward A. *See* Engdahl, Eric R. 00033

05626 **Folk, Robert L.** Bimodal supermature sandstones—Product of the desert floor, *in* Internat. Geol. Cong., 23d, Prague, 1968, Proc., Sec. 8, Genesis and classification of sedimentary rocks: Prague, Academia, p. 9–32, illus., table, 1968.

Bimodal-supermature sandstones consist of two well-sorted and rounded size modes, separated by a gap of 2–3 Udden-Wentworth classes. Typically, well-sorted, rounded grains of CSd-VCSd are studied in a matrix of well-sorted VFSd. This textural inversion is common in lower Paleozoic sandstones of North America. Bimodality is characteristic of desert lag deposits and is a product of the dynamics of wind action, not of source area. Dunes are relatively well-sorted unimodal fine sands, while deflationary flats (reg) become veneered with bimodally well-sorted CSd and VFSd. Such bimodal distributions may be preserved through incorporation into shallow marine deposits.—*from* Author's abstract

Folsom, T. R. *See* Sreekumaran, C. 05345

Ford, R. E. *See* MacIsaac, W. 05307

00003 **Foster, Theodore D.** Convection in a variable viscosity fluid heated from within: Jour. Geophys. Research, v. 74, no. 2, p. 685–693, illus., tables, 1969.

A time-dependent theoretical model of finite amplitude thermal convection in a layer of fluid that has a variable viscosity and that is heated from within is developed. Numerical results are presented for the case where the viscosity increases exponentially with depth for a range of rates of increase with depth and a range of Rayleigh numbers that may be appropriate for the Earth's mantle. It is found that convection is confined largely to the low-viscosity zone and that the cells are shortened in horizontal extent. A steady state was not reached in any case considered. Initial thermal structure is found to drastically affect the history and pattern of convection, and thus the theory cannot provide much constraint to speculations about mantle convection.—Author's abstract

Fox, J. *See* Card, K. D. 05465

Fox, J. *See* Card, K. D. 05466

Fox, J. *See* Card,K.D.05467

05620 **Fox, Richard C.** Therians and quasi-mammals [discussion of "Foramen pseudovale and quasi-mammals" by G. T. MacIntyre, 1967]: Evolution, v. 22, no. 4, p. 839–840, 1968.

MacIntyre [ibid., v. 21, no. 4, p. 834–841, 1967] proposes restriction of Mammalia to "Theria of current usage", and designation as "quasi-mammals" of monotremes, triconodonts, multituberculates, symmetrodonts, haramyids, and docodonts. Fox points out that symmetrodonts are explicitly included within Theria by many authors, and that Late Triassic Welsh symmetrodonts have dentition and lower jaw

structure qualifying them as therians. As to other of MacIntyre's criteria, possession of a cochlea of one full coil and pre-tribosphenic or tribosphenic molars in Mesozoic fossils, evidence of the cochlear coil is mostly lacking from the Mesozoic record of all mammalian lineages, and there is no great difference in molar morphologies of the earliest mammals and "quasi-mammals".—VMJ

05678 **Fox, William T.** Quantitative paleoecologic analysis of fossil communities in the Richmond Group: Jour. Geology, v. 76, no. 6, p. 613–640, tables, 1968.

Thin-bedded limestone and shale beds of the Late Ordovician Tanner Creek Formation in southeastern Indiana were divided into five assemblage zones using time-trend curves. Within each assemblage zone, the fossils which occur most frequently together were grouped into communities using R-mode cluster analysis. Factor analysis was used to study the relationships between the fossil associations and the physical and chemical parameters of their environment as interpreted from thin section and field data. It is concluded that the Tanner Creek Formation was laid down in a carbonate basin during a marine regression which was interrupted by a transgressive phase near the end of its deposition. The distribution of benthonic organisms changed in response to changes in the physical environment during the regression.—FSF

05717 **Frick, Childs; Taylor, Beryl E.** A generic review of the stenomyline camels: Am. Mus. Novitates, no. 2353, 51 p., illus., tables, 1968.

The subfamily Stenomylinae includes three genera, *Stenomylus* Peterson (1906), *Rakomylus* Frick (1937), and *Blickomylus*, a new genus. A new subgenus, *Stenomylus (Pegomylus)*, is distinguished by extremely large premolars, and represents an ancient lineage. *Blickomylus* is more advanced than *S. (Stenomylus)* and is characterized by further reduction of premolars and an anteroposterior expansion of the third molars. The Stenomylinae are known only from Miocene sediments. The subfamily ranged from California east to Arizona, New Mexico, and Texas, and north to Nebraska, Wyoming, and Montana.—KAF

Fritts, J. J. *See* Ensign, C. O., Jr. 05409

Frost, J. E. *See* Eidel, J. J. 05430

05699 **Frost, S. H.; Langenheim, R. J., Jr.** New name for the rugose coral *Temnophyllum waltheri* Frost and Langenheim: Jour. Paleontology, v. 42, no. 5, p. 1313, 1968.

To replace the homonym preoccupied by Yoh (1937), the name *Temnophyllum spiculi* Frost and Langenheim is substituted for a coral described from the Middle Devonian Piute Formation in Nevada (1966).—REG

Fryklund, Verne C., Jr. *See* Hobbs, S. Warren. 05346

05355 **Full, Roy P.; Grantham, Robert M.** Ore deposits of the Republic mining district, Ferry County, Washington, *in* Ore deposits of the United States, 1933–1967 (Graton-Sales Volume), V. 2: New York, Am. Inst. Mining, Metall. and Petroleum Engineers, p. 1481–1494, illus., 1968.

The Republic graben developed in early Tertiary time and became the center of extensive volcanic activity in the Eocene and Oligocene. Continued subsidence during the volcanism resulted in structures which were later the control for gold-bearing quartz veins. The veins, varying from a few feet to more than 50 feet wide, are filled by fine-grained quartz. Finely laminated dark-gray to black concentric banding within the veins distinguishes the better-grade ore zones, which contain finely disseminated sulfides and ore minerals that include principally electrum, stephanite, naumannite, and native silver.—*from* Authors' abstract

05193 **Gair, Jacob E.; Simmons, George C.** Palmer Gneiss—An example of retrograde metamorphism along an unconformity, *in* Geological Survey research 1968, Chap. D: U.S. Geol. Survey Prof. Paper 600-D, p. D186–D194, illus., table, 1968.

Van Hise and Bayley concluded in 1895 that the Palmer Gneiss in the Marquette district, Mich., was formed by deformation and alteration of Archean granitic and amphibolitic gneiss; since then this has been challenged many times. Data recently assembled by us, however, support Van Hise and Bayley. We similarly attribute origin of the gneiss to folding and shearing and to later alteration by solutions of probable metamorphic origin that passed along the unconformity between lower Precambrian gneiss and middle Precambrian metasedimentary rocks. Thin sections and mapping reveal gradations from slightly altered gneiss to extensively sericitized, chloritized, carbonatized, and silicified rocks of the Palmer Gneiss. Chemical analyses of dolomite–chlorite and quartz–sericite varieties of the Palmer Gneiss indicate similarities to amphibolitic and felsic parts of the basement gneiss.—*from* Authors' abstract

05737 **Galbraith, Frank W.** Effect of a fault on explosion-generated ground shock spectra: Seismol. Soc. America Bull., v. 58, no. 6, p. 2033–2041, illus., 1968.

Shock spectrum measurements were made for an underground nuclear explosion at the Nevada Test Site using 29 reed gages to determine the effect of a fault zone on shock spectrums measured at the ground surface and generated by the explosion. Results showed that the fault zone had an effect on vertical but not on horizontal radial spectrums. The vertical gage directly on the fault showed significantly lower displacements for all frequencies about 3 hz but no apparent effect on the 3 hz displacement. For gages beyond the fault the vertical spectrums for frequencies higher than 3 hz were greater than for corresponding gages along the north gage line. It is believed that this was caused by the upthrust base rock on the side of the fault away from the explosion with a resultant decreased thickness of tuff and alluvium. This resulted in less attenuation of high frequency response than was expected.—*from* Author's abstract

05597 **Galley, John E.** (editor). Subsurface disposal in geologic basins—A study of reservoir strata: Am. Assoc. Petroleum Geologists Mem. 10, 253 p., illus., tables, 1968.

The memoir contains 10 papers, 9 of which are cited separately. Following an introductory chapter, six papers describe geologic basins where disposal methods might be used successfully and three discuss the limitations and principles governing subsurface-disposal techniques.—ESL

05598 **Galley, John E.** Economic and industrial potential of geologic basins and reservoir strata, *in* Subsurface disposal in geologic basins—A study of reservoir strata: Am. Assoc. Petroleum Geologists Mem. 10, p. 1–10, 1968.

This introductory paper reviews methods of waste disposal. The subsurface geologist is uniquely qualified to serve as adviser on these problems. Initial steps in the program leading up to this AAPG study are reviewed. Six basins to be studied were selected by a subcommittee of the Research Commission. Suggested methods were: deep-well injection into permeable reservoirs, and disposal in salt and in artificial fractures. The importance of structural basins, and of subsurface analyses in site selection are reviewed.—ESL

00034 **Gammon, J. B.; Borcsik, M.; Holland, H. D.** Potassium–sodium ratios in aqueous solutions and coexisting silicate melts: Science, v. 163, no. 3863, p. 179–181, illus., 1969.

Silicate melts were equilibrated with aqueous chloride solutions at temperatures between 770° and 880°C and a total pressure of 1.4 to 2.4 kbars. The ratio of potassium to sodium in the aqueous phase was 0.74 ± 0.06 times the corresponding ratio in the coexisting melt over the entire range of temperature and pressure for all chloride concentrations between 0.2 and 4.2 moles per kgm.—Authors' abstract

05605 **Garbarini, George S.; Veal Harry K.** Potential of Denver basin for disposal of liquid wastes, *in* Subsurface disposal in geologic basins—A study of reservoir strata: Am. Assoc. Petroleum Geologists Mem. 10, p. 165–185, illus., table, 1968.

Three types of reservoirs are available for waste disposal in the basin: fractured Precambrian rocks, porous sandstones, and thick shale suitable for disposal by hydraulic fracturing. For four years, fractured Precambrian rocks at a depth of 12,000 feet were used as a disposal reservoir; the well is now shut pending investigation of a possible relation between the waste injection and area earthquakes. Most favorable porous sandstone reservoirs are the Permian Lyons, Triassic Dockum, Triassic–Jurassic Jelm–Entrada, and sandstones in the Cretaceous Dakota and "Hygiene zone" of the Pierre. Cretaceous black shale suitable for hydraulic fracturing is present everywhere.—*from* Authors' abstract

05377 **Garmoe, W. J.** Breccia structures in the Ontario mine, Park City district, Utah, *in* Ore deposits of the United States, 1933–1967 (Graton–Sales Volume), V. 2: New York, Am. Inst. Mining, Metall. and Petroleum Engineers, p. 1127, 1968.

Distinct areas of mineralized and nonmineralized breccia are found in the Humbug and Deseret Formations. The breccias contain an appreciable amount of ore. Three ages of breccia have been recognized: (1) premineral breccia that may or may not be mineralized, (2) early post–mineral breccia with mineralized fragments, and (3) late post–mineral breccia that cuts through the other two. The breccias, which steeply crosscut the moderately dipping sedimentary rocks, occasionally will follow a particular sedimentary bed for a short distance, but are not known within the igneous rocks of the district. While some are original sedimentary structures, others may be collapse features. Another possibility is that brecciation associated with predetermined structures may have resulted from fluidization or gas release accompanying igneous activity.—HRC

05378 **Gemmill, Paul.** The geology of the ore deposits of the Pioche district, Nevada, *in* Ore deposits of the United States, 1933–1967 (Graton–Sales Volume), V. 2: New York, Am. Inst. Mining, Metall. and Petroleum Engineers, p. 1128–1147, illus., table, 1968.

Production in the Pioche district is from replacement lead–silver–zinc orebodies in Cambrian limestone. All of the orogenic history is related to Basin and Range faulting. Faults developed after mid–Tertiary time, and after widespread extrusives that are themselves involved in the faulting. Flat faults are interpreted as gravity sliding. The mineralization is later than the faulting. A single mineralization period began with introduction of iron–manganese carbonates and, in places, carbonate manganese with minor sulfides; these were followed by massive sulfides, replacing part of the carbonate body and unmineralized limestone. —*from* Author's abstract

Gerdemann, Paul E. *See* Snyder, Frank G. 05404

05645 **Gibbs, G. V.; Breck, D. W.; Meagher, E. P.** Structural refinement of hydrous and anhydrous synthetic beryl, $Al_2(Be_3Si_6)O_{18}$ and emerald, $Al_{1.9}Cr_{0.1}(Be_3Si_6)O_{18}$: Lithos, v. 1, no. 3, p. 275–285, illus., tables, 1968.

Positional and thermal parameters of synthetic beryl and emerald were refined by least–squares and difference Fourier methods using 3D data recorded with a counter diffractometer. Mean Be–O and Si–O bond distances determined for the four crystals are statistically identical and measure on the average 1.657(2) and 1.609(1)A, respectively, the latter value consistent with that expected for a framework structure. Si–O bonds are longer to 3–coordinated than to 2–coordinated oxygen atoms. The cation oxygen distances in the octahedra containing Al, Cr in both emeralds are significantly longer than comparable Al–O distances in beryl. Isotopic temperature factors are smaller for 3–coordinated than 2–coordinated oxygen atoms in all structures. Broad, low peaks of electron density in hydrous specimens are ascribed to water molecules weakly hydrogen–bonded to oxygen atoms in cavity walls.—*from* Authors' abstract

Gibson, Everett K. *See* Moore, Carleton B. 00031

05234 **Gibson, Thomas G.; Hazel, Joseph E.; Mello, James F.** Fossiliferous rocks from submarine canyons off the northeastern United States, *in* Geological Survey research 1968, Chap. D: U.S. Geol. Survey Prof. Paper 600–D, p. D222–D230, illus., tables, 1968.

Ages, based on Foraminifera and Ostracoda, are assigned to 74 rock samples collected from 13 Atlantic coast submarine canyons between 37° and 42° north latitude. Strata of Paleocene, middle Eocene, Oligocene, and early Miocene age are recorded for the first time in this offshore area, representing a considerable northward extension of deposits of these ages. Strata of Late Cretaceous, early Eocene, late Miocene, and Pleistocene age were also found. Station location, collecting equipment, lithology, and age-diagnostic species are given for each of the 74 samples.—Authors' abstract

Gill, Harold E. *See* Clark, Glenn A. 05640

05680 **Gilman, Richard A.** Kink bands of non-tectonic origin: Jour. Geology, v. 76, no. 6, p. 702–709, illus., table, 1968.

Microscopic kink bands, or sharp angular changes in crystal orientation, are present in a thin continuous zone around the lateral edges of discus-shaped cone-in-cone concretions in undeformed Upper Devonian shales of western New York. The kink bands are interpreted as having formed in response to expansion of the concretions while the enclosing sediment was still plastic.—*from* Author's abstract

05429 **Gilmour, Paul; Still, Arthur R.** The geology of the Iron King mine, *in* Ore deposits of the United States, 1933–1967 (Graton-Sales Volume), V. 2: New York, Am. Inst. Mining, Metall. and Petroleum Engineers, p. 1238–1257, illus., table, 1968.

The ore occurs in steeply-dipping metamorphosed eugeosynclinal sedimentary and volcanic rocks of Precambrian age. The ore lies at the contact of rhyolitic tuff and interbedded andesite with underlying andesite tuffs, minor rhyolitic tuffs, and argillaceous sediments. The ore is overlapping, conformable, or massive pyrite bodies and associated lenses of massive quartz containing gold, silver, lead, zinc, and copper. A parallel zone of copper occurs within the hanging wall. The orebodies were formed through the agency of volcanic hot springs on or near a submarine surface of deposition.—*from* Authors' abstract

00042 **Glover, Peter; Alexander, S. S.** Lateral variations in crustal structure beneath the Montana LASA: Jour. Geophys. Research, v. 74, no. 2, p. 505–531, illus., tables, 1969.

The analysis of a variety of geologic and geophysical data indicates that significant lateral variations in crustal structure exist across the large aperture seismic array (LASA). This structural complexity is inferred from observation of Rayleigh-wave dispersion, body-wave spectral ratios, P-wave amplitude and travel-time anomalies, seismic refraction profiles, and gravity and magnetic anomalies. To explain these results, we divide LASA into an eastern and a western sector. An attempt is then made to explain the observations in each sector in terms of crustal models consisting of three to five distinct layers. The observations show that the maximum lateral change in structure across LASA takes place in a NE–SW direction.—Authors' abstract

05556 **Gluskoter, Harold J.; Simon, Jack A.** Sulfur in Illinois coals: Illinois Geol. Survey Circ. 432, 28 p., illus., 1968.

Data developed over many years were analyzed, and the following observations and conclusions resulted. Sulfur is present in coal as sulfide, as sulfate, and in organic combination. The sulfide occurs mostly as pyrite; sulfates are usually of little significance except in weathered coals. There is a wide range of both pyritic and organic sulfur in face-channel samples of coal, but the range is less for organic. The pyritic sulfur content is usually greater in the fusain bands, and organic to pyritic ratios are higher in vitrain and clarain, the latter being richest in organic sulfur. Three areas of low-sulfur coals can be outlined: Herrin No. 6 coal in south-central and southwestern Illinois, and an area of Harrisburg No. 5 coal in the southeast. Organic sulfur content is more uniform throughout a vertical section than pyritic.—*from* Authors' abstract

Goddard, Charles C., Jr. *See* Meyer, Charles. 05351

05295 **Godovikov, Alexander A.; Kennedy, George C.** Kyanite eclogites: Contr. Mineralogy and Petrology, v. 19, no. 2, p. 169–176, illus., tables, 1968.

Prior experimental work has shown that in the laboratory the mineralogy of eclogites is sensitive to the ratio CaO:MgO:FeO and that the reaction pyroxene + kyanite ⇆ garnet + quartz proceeds to the right at high pressures in rocks rich in magnesium and to the left in rocks rich in calcium and iron. Typical basalts crystallized at high pressure never contain kyanite. The chemistry and mineralogy of a large number of eclogites show they belong to three classes: (1) kyanite-free magmatic eclogites, rich in magnesium from kimberlites, dunites, and serpentinites; (2) kyanite-bearing eclogites and grosspydites rich in CaO and low in FeO with intermediate MgO from kimberlites and gneisses; and (3) kyanite-free eclogites of metamorphic origin rich in iron and low magnesium and intermediate amounts of calcium from glaucophane schist and gneisses.—Authors' abstract

Goebel, Edwin D. *See* Edmund, R. W. 05604

05173 **Goldberg, Marvin C.; Babad, Harry; Groothius, Dennis; Christianson, H. R.** Nuclear magnetic resonance studies of phosphorus(V) pesticides—[Pt.] 3, The hydrolysis of aliphatic pesticides by aqueous solutions, *in* Geological Survey research 1968, Chap. D: U.S. Geol. Survey Prof. Paper 600-D, p. D20–D23, illus., table, 1968.

Contrary to expectations, Cygon, Dyfonate, and Malathion hydrolyze slowly in treatment with stoichiometric amounts of water at ambient temperatures in the pH range of natural water. Nuclear magnetic resonance measurements showed the half life for the hydrolysis process to be greater than two weeks.—Authors' abstract

Goodacre, A. K. *See* Weber, J. R. 05476

00017 **Gordon, R. B.; Davis, L. A.** Reply [to comments on paper by R. B. Gordon and L. A. Davis, "Velocity and attenuation of seismic waves in imperfectly elastic rock" (1968)]: Jour. Geophys. Research, v. 74, no. 2, p. 729–730, illus., 1969.

The possibility is not excluded that more than one dissipation mechanism operates under the conditions covered by the experiments reported by Gordon and Davis (ibid., v. 73, p. 3917–3935, 1968). However, there is indirect evidence that the low-amplitude damping is nonlinear, not linear as Savage suggests (ibid., v. 74, p. 727–728, 1969).—DBV

Gottfried, David. *See* Greenland, L. Paul. 05293

05739 **Gould, Stephen Jay.** Ontogeny and the explanation of form—An allometric analysis, *in* Paleobiological aspects of growth and development, a symposium: Paleont. Soc. Mem. 2 (Jour. Paleontology, v. 42, no. 5, supp.), p. 81–93, illus., tables, 1968.

Significant allometry occurs during the ontogeny of every variable in *Poecilozonites bermudensis*, a Pleistocene–Recent land snail in Bermuda. The adaptive significance of shell allometry may lie in the necessity for preserving a high value of the foot surface/body volume ratio. Paedomorphosis, the primary evolutionary event in *P. bermudensis*, has occurred several times during the Pleistocene, providing an example of iterative evolution at the infraspecific level. Four paedomorphic subspecies are known; they have the geographic distribution expected of diverging populations, and seem to be genetically distinct entities, not mere phenotypic variants.—*from* Author's abstract

05766 **Gow, Anthony J.** Electrolytic conductivity of snow and glacier ice from Antarctica and Greenland: U.S. Army Materiel Command Cold Regions Research and Eng. Lab. Research Rept. 248, 8 p., illus., tables, 1968.

Conductivity measurements have been made on snow and ice samples from pits and deep drill holes at a number of localities in Antarctica and Greenland. Conductivities of the order 1–2 μmho/cm only were recorded at the inland sites. Data from deep cores representing more than 1,900 years of continuous snow

accumulation at Byrd Station, Antarctica, and more than 400 years of deposition at Inge Lehmann, Greenland, showed no significant variations of conductivity with time.—*from* Author's abstract

05448 **Grant, A. C.** Seismic-profiler investigation of the continental margin northeast of Newfoundland: Canadian Jour. Earth Sci., v. 5, no. 5, p. 1187–1198, illus., 1968.

Seismic records over the continental shelf northeast of Newfoundland show unconsolidated sediments ranging in thickness from 30 to 150 m, unconformably overlying bedrock that dips gently eastward. This distribution indicates that the banks of the 'shelf-edge rise' are not morainal material, but are areas of positive relief on the bedrock surface; anomalous strike-dip relations suggest they also have structural significance. The bedrock layers are truncated by the continental slope, and there is reversal in dip from east to west beneath the slope. The axial zone of the resulting fold seems to coincide very nearly with that of a large magnetic anomaly along the continental margin. Tertiary or post-Tertiary age is suggested for the fold and structural disturbance associated with shelf topographic relief. The continental margin northeast of Newfoundland seems similar to that to the south on the flank of the Appalachians.—Author's abstract

05214 **Grant, James A.** Partial melting of common rocks as a possible source of cordierite-anthophyllite bearing assemblages: Am. Jour. Sci., v. 266, no. 10, p. 908–931, illus., table, 1968.

In a high grade regional metamorphic environment, partial melting and removal of melt will result in a residuum different in composition from the original rock. The possibility that these processes may produce cordierite-anthophyllite bearing rocks is investigated in the system Al_2O_3–MgO–K_2O–Na_2O–SiO_2–H_2O and the development of a petrogenetic grid. These rocks could be formed from such common pre-melting assemblages as potassium feldspar-plagioclase-biotite-sillimanite-quartz and hence from various common protoliths by partial melting filter pressing, and recrystallization. Development of the grid elucidates the possible formation of granitic melts from assemblages not containing K-feldspar or muscovite, or by incongruent melting of quartz-plagioclase-biotite with or without sillimanite or cordierite.—*from* Author's abstract

Grantham, Robert M. *See* Full, Roy P. 05355

05282 **Graton, L. C.** Lindgren's ore classification after fifty years, *in* Ore deposits of the United States, 1933–1967 (Graton-Sales Volume), V. 2: New York, Am. Inst. Mining, Metall. and Petroleum Engineers, p. 1703–1712, 1968.

In his textbook, Lindgren analyzed ore-forming processes under conditions prevailing from great depth up to the surface, explained the nature of deposition in each environment, and developed a comprehensive *genetic* ore classification which brought widespread acceptance. Current publications regarding ores now emanate from a generation caught in pressures of the breathless modern tempo. Many of today's ideas need challenge because they supplant interrelationship and system by what seems to be, collectively, an assemblage of strange, *ad hoc* and often self-contradictory concepts. Some profit may result, but at great expense. Numerous post-Lindgren advances are described and show that Lindgren's philosophy, progressively improved, remains the soundest approach to understanding ore genesis.—*from* Author's abstract

Gray, Fenton. *See* Stiegler, Jim. 05271

05359 **Gray, Raymond F.; Hoffman, Victor J.; Bagan, Richard J.; McKinley, Harold L.** Bishop tungsten district, California, *in* Ore deposits of the United States, 1933–1967 (Graton-Sales Volume), V. 2: New York, Am. Inst. Mining, Metall. and Petroleum Engineers, p. 1531–1554, illus., tables, 1968.

The orebodies in the district consist of scheelite-bearing tactite formed by the pyrometasomatic replacement of calcareous sediments along the contact with an acidic granite intrusive. A number of metasedimentary remnants have had tungsten deposited along their edges. Deposits in the Pine Creek pendant have been found

along a marble—quartz-monzonite contact for a distance of 2.5 miles and over a 3700-ft vertical distance. Orebodies along this contact are controlled by irregularities of the granitic contact and other factors. The Donut orebody had the most complete zoning observed in the Pine Creek mine. There was no significant temperature gradient during the formation of this ore zone; the zoning must be a product of a chemical gradient. The tactite has formed under pneumatolitic conditions at a temperature just under 700°C.—*from* Authors' abstract

Gray, Tunstall R. *See* Simpson, Thomas A. 05384

05293 **Greenland, L. Paul; Gottfried, David; Tilling, Robert I.** Distribution of manganese between coexisting biotite and hornblende in plutonic rocks: Geochim. et Cosmochim. Acta, v. 32, no. 11, p. 1149–1163, illus., tables, 1968.

The distribution of manganese between coexisting biotite and hornblende for 80 minerals pairs from igneous rocks of diverse provenance has been determined by neutron activation analysis. Data on the distribution ratio of Mn in hornblende to Mn in biotite indicate that an equilibrium distribution of Mn is closely approached in most samples from plutonic environments. Comparison of Mn ratios of mineral pairs with bulk chemical composition of host rocks reveals no correlation. Because initial crystallization temperatures vary with rock composition, lack of correlation of composition with Mn ratios suggests that equilibrium distribution of Mn between biotite and hornblende reflects exchange at subsolidus temperatures rather than initial crystallization temperatures. The highest Mn ratios are for volcanic rocks, in which rapid quenching prevents subsolidus redistribution of Mn.—*from* Authors' abstract

05425 **Griffitts, Wallace R.; Alminas, Henry V.** Geochemical evidence for possible concealed mineral deposits near the Monticello Box, northern Sierra Cuchillo, Socorro County, New Mexico: U.S. Geol. Survey Circ. 600, 13 p., illus., 1968.

Geochemical surveys indicate that mineralization along a north-trending belt near the east edge of the volcanic field of southwestern New Mexico is associated with areas of alteration. The rocks of the Monticello Box area consist of latite and andesite and overlying rhyolitic flows and tuffs, cut by faults of little displacement, and locally subjected to argillic or chloritic alteration. Unexposed Paleozoic rocks may underlie the lowest latite. Thus the volcanics may be barren caprocks altered by solutions escaping from ore deposits in the underlying limestones. Concentrates panned from arroyo sediments southeast of Monticello Box contain up to 2 percent lead, at least 0.2 percent each of molybdenum, zinc, and copper, and anomalous amounts of barium and silver. The sources of these metals are areas of chloritized rock, fillings of small fissures, and perhaps some northeast-trending mineralized fault zones.—*from* Authors' abstract

00036 **Grim, Paul J.; Naugler, Frederic P.** Fossil deep-sea channel on the Aleutian abyssal plain: Science, v. 163, no. 3865, p. 383–386, illus., 1969.

The discovery of a leveed deep-sea channel whose axial gradient reverses near the Aleutian trench supports the hypothesis that the downbowing of the trench interrupted the turbidity current processes that constructed the Aleutian abyssal plain.—Authors' abstract

Grim, Ralph E. *See* Couch, Elton L. 05570

05684 **Grim, Ralph E.; Wahl, F. Michael.** The kaolin deposits of Georgia and South Carolina, U.S.A., *in* Internat. Geol. Cong., 23d, Prague, 1968, Proc., Symposium 1, Genesis of kaolin deposits: Prague, Academia, p. 9–21, illus., 1968.

The Cretaceous section of Georgia and South Carolina contains extensive sedimentary beds of kaolin which are the source of large production of this clay for the paper, ceramic, and other industries. Many of the beds are composed of almost pure well crystallized kaolinite; other beds contain small but significant amounts of smectite; still others contain small but important amounts of quartz, feldspar, and organic material. There is slight but significant variation in the size and crystallinity of the kaolinite particles. The source of the kaolinite is believed

to be primary kaolins in the Appalachians. The origin of such pure kaolinite deposits so far from the source probably involved secondary concentration by weathering and sedimentary processes in an intermediate coastal environment.—*from* Authors' abstract

Grimaldi, F. S. *See* Schnepfe, Marian M. 05197

05406 **Grogan, Robert M.; Bradbury, James C.** Fluorite-zinc-lead deposits of the Illinois-Kentucky mining district, *in* Ore deposits of the United States, 1933-1967 (Graton-Sales Volume), V. 1: New York, Am. Inst. Mining, Metall. and Petroleum Engineers, p. 370-399, illus., tables, 1968.

The structural apex of the district is Hicks dome, a sharply-defined, oval-shaped uplift that contains many outcrops of intrusive breccia, some of which are mineralized; the dome is volcanic in origin. Mineralization is Permian or younger, possibly Late Cretaceous, by isotopic analysis and structural-stratigraphic relations. Vein deposits from fissure-filling along faults and bedding-replacement deposits are the two ore types. Fluorite is the chief valuable mineral, and locally sphalerite and galena are abundant and important. Calcite is the chief gangue mineral, and quartz and barite are present in various amounts. The localization of the ores by faults and fractures and various lines of petrographic and geochemical evidence suggest an epigenetic origin and deposition by solutions from deep alkaline magma.—*from* Authors' abstract

Groothius, Dennis. *See* Goldberg, Marvin C. 05173

05422 **Gross, Stanford O.** Titaniferous ores of the Sanford Lake district, New York, *in* Ore deposits of the United States, 1933-1967 (Graton-Sales Volume), V. 1: New York, Am. Inst. Mining, Metall. and Petroleum Engineers, p. 140-153, illus., table, 1968.

The Sanford Lake district is within the large anorthosite massif making up the central high peak area of the Adirondacks. Gabbro and ore associated with it show flow structure as foliation and lineation. Anorthosite and its associated ores are massive and show little primary structure. Faulting is prevalent and follows a regional pattern. There are four mineralized areas; three have gabbroic- and anorthositic-type ores,; the fourth has only gabbroic-type ore. The TiO_2 contents range from 9.5 to over 30 percent. Although complete agreement probably never will be reached, it is certain that no one process of ore-emplacement can explain the complicated picture as seen today.—*from* Author's abstract

00023 **Grutt, E. W., Jr.** Uranium exploration in Wyoming and new exploration techniques, *in* Report on Wyoming Governor's Conf. on Uranium, Casper, Wyo., 1968: Mines Mag., v. 59, no. 1, p. 17-19, 1969.

In the 1950's, many uranium deposits were found in several Tertiary basins in Wyoming by intensive airborne and surface radiometric exploration and by drilling. Exploration in these and other basins in Wyoming in the late 1960's was even more intensive; more sophisticated geochemical and geophysical exploration methods are available for use and are being used with drilling.—RPF

05565 **Guilbert, J. M.; Sloane, R. L.** Electron-optical study of hydrothermal fringe alteration of plagioclase in quartz monzonite, Butte district, Montana [with French, German, and Russian abs.]: Clays and Clay Minerals, v. 16, no. 3, p. 215-221, illus., 1968.

Andesine plagioclase is one of the outermost minerals destroyed in the hydrothermal alteration of the Butte quartz monzonite. Replicas of fresh, incipiently, and thoroughly montmorillonitized grains reveal a complex sequence of events that may follow alternate equivalent paths. Quantitatively most important is formation of a hobnail texture composed of 0.5μ discoids of amorphous material on feldspar cleavage surfaces; these discoids appear to fuse laterally to form amoeboid or lobate amorphous clusters. Some assume progressively more polygonal outlines characterizing montmorillonite morphology, or fringes become flake-like montmorillonite which peels away in wisps from the pitted feldspar surface. Less

commonly, plagioclase develops micrograins and wisps of montmorillonite without a discernible amorphous stage. The alternative paths are probably influenced by chemical activity of magnesium in the system.—*from* Editor's abstract

05529 **Gunn, C. B.** Provenance of diamonds in the glacial drift of the Great Lakes region, North America [abs.]: Bull. Canadian Petroleum Geology, v. 16, no. 3, p. 418, 1968.

05659 **Guthrie, R. D.** Paleoecology of a late Pleistocene small mammal community from interior Alaska: Arctic, v. 21, no. 4, p. 223–224, illus., table, 1968.

Fossil small mammals from late Pleistocene sediments in interior Alaska were used to investigate the paleoecology of the region. The predominant member of the fossil assemblage was *Microtus gregalis* indicating that the area was above tree line and occupied by a fauna and flora which preferred well-drained soils. Three species were found as fossils which are not in the area today: *Microtus gregalis, Citellus undulatus,* and *Dicrostonyx torquatus.* Their extinction in interior Alaska appears to be due to a rapid reduction of their preferred habitat at the end of the Wisconsin glaciation. The ecological interpretation of the paleocommunity and its extinction is consistent with interpretations from fossil large mammal assemblages from the same area.—Author's abstract

05674 **Gutschick, Raymond C.** Late Mississippian (Chester) *Allagecrinus* (Crinoidea) from Illinois and Kentucky: Jour. Paleontology, v. 42, no. 4, p. 987–999, illus., tables, 1968.

Three localities in southern Illinois and western Kentucky have yielded about 270 tiny crinoids, all belonging to two new species of *Allagecrinus. A. coronarius,* n.sp., is from the Shetlerville Member of Renault Formation and the Ridenhower (Paint Creek) Formation, low in the Chester Series; *A. elegantulus* n.sp., is from the Cave Hill Member of Kinkaid Limestone, high in the Chester. Ontogeny progresses from armless forms to eight-armed forms, to one specimen with 14 arms. Phylogeny of the genus shows progressive decrease in height and increase in width of the calyx. The Chester species are compared with Lower Carboniferous species of Scotland.—REG

Gutschick, Raymond C. *See* Rodriguez, Joaquin. 05769

05402 **Hagner, Arthur F.** The titaniferous magnetite deposit at Iron Mountain, Wyoming, *in* Ore deposits of the United States, 1933–1967 (Graton-Sales Volume), V. 1: New York, Am. Inst. Mining, Metall. and Petroleum Engineers, p. 665–680, illus., tables, 1968.

The Iron Mountain deposit is in a Precambrian anorthosite. Individual ore bodies are lenses, commonly arranged en echelon, conformable to the platy crystal structure and compositional layering of the anorthosite; a few transect these features. Magnetite and ilmenite, accompanied by spinel, are the ore minerals. Westward-bowing curves of the anticlinal axis were favorable for localization of the two largest ore bodies. The ore formed by replacement of anorthosite as indicated by (1) marked changes in mineralogy along strike, dip, and plunge of the ore body, (2) concentration of massive ore in folds and olivine on the limbs, (3) the halo of low-grade mineralized rock that transects the structure, and (4) layering in the southern ore body.—*from* Author's abstract

05461 **Hales, A. L.; Cleary, J. R.; Roberts, J. L.** Velocity distribution in the lower mantle: Seismol. Soc. America Bull., v. 58, no. 6, p. 1975–1989, illus., tables, 1968.

Study of P-wave traveltimes to North American stations from 20° to 96° confirms the existence of a second major discontinuity in the traveltime curve at 25° and shows that there are no other major ones up to 96°. There may be minor discontinuities or irregularities in the traveltime curves, especially one between 53° and 59°, that are real. The major outstanding problem is that the traveltimes for sets of data in which western events are dominant differ systematically from those for sets in which the distribution in azimuth is reasonably uniform. The possibility exists that there are regional differences in the lower mantle, as suggested by

Chinnery and Toksöz (1967). P-velocities calculated using the Herglotz-Wiechert inversion method are tabulated.—DBV

05451 **Haley, Boyd R.; Hendricks, Thomas A.** Geology of the Greenwood quadrangle, Arkansas-Oklahoma: U.S. Geol. Survey Prof. Paper 536-A, p. A1-A15, illus., tables, geol. map, 1968.

The Greenwood quadrangle is between lat 35°00′ and 35°15′ N., and long 94°15′ and 94°30′ W. in Arkansas and Oklahoma. Sedimentary rocks of Middle Pennsylvanian to Late Cambrian age have been folded into eastward-trending synclines and anticlines and broken by normal faults with maximum displacement of 1,100 feet and by reverse faults with maximum displacement of 12,800 feet. Coal has been produced principally from the Lower Hartshorne coal bed. Natural gas has been produced from the McAlester, Hartshorne, and Atoka Formations, Morrow Series, and Penters and St. Clair Formations. Building stone and road metal have been produced from the Savanna, McAlester, Hartshorne, and Atoka Formations and from alluvial deposits.—BRH

05475 **Hall, Donald H.** Regional magnetic anomalies, magnetic units, and crustal structure in the Kenora District of Ontario: Canadian Jour. Earth Sci., v. 5, no. 5, p. 1277-1296, illus., table, 1968.

Regional magnetic anomalies smoothed from aeromagnetic maps in part of the Superior Province showed that anomaly lows lie over Keewatin greenstone belts, and highs over adjacent granitic areas. Surface mapping of magnetic susceptibility and NRM combined with quantitative interpretation of regional magnetic anomalies indicated that magnetization lies primarily in the granitic bodies, with a continuous distribution from the surface down to the Intermediate (Conrad) discontinuity. Intensity of magnetization increases with depth, and is directed nearly along present-day geomagnetic field. As an aid to interpretation a method of depth determination for deep crustal magnetic units with sloping sides is introduced, and one for variable intensity of magnetization with depth.—*from* Author's abstract

05488 **Hall, Warren A.; Dracup, John A.** The optimum management of ground water resources [with French and Spanish summ.], *in* Water for peace—Internat. Conf., Washington, D.C., 1967—V. 3, Water supply technology: Washington, D.C., U.S. Govt. Printing Office, p. 20-27, 1968.

Current management practice of ground-water resources uses as guides the annual recharge and volume of ground water capable of being mined. In addition the ground-water basin may be used as a reservoir for long-term storage or as a transmission system in many cases, as an energy resource in that pumping lifts are modified by management, and it can serve as a valuable water quality management function resulting from filtering characteristics of aquifer and recharge areas. An optimal management policy will reflect interplay of all six together with the potential or existing surface supply system for the region. Planning must also consider problems of land subsidence, sea-water intrusion, deterioration in quality, and necessary changes in legal and institutional framework governing ground-water usage.—MCM

Hamilton, C. G. *See* Dagenais, J. E. 05309

05347 **Hammer, Donald F.; Peterson, Donald W.** Geology of the Magma mine area, Arizona, *in* Ore deposits of the United States, 1933-1967 (Graton-Sales Volume), V. 2: New York, Am. Inst. Mining, Metall. and Petroleum Engineers, p. 1282-1310, illus., tables, 1968.

The deposit is mesothermal, and while the bulk of the ore has come from the Magma vein, current production comes from limestone replacement deposits. Precambrian and Paleozoic rocks are intruded by Mesozoic igneous rocks which were the probable source of ore fluids. The Magma vein-fault is the principal mineralized structure. The bulk of the ore occurs in large shoots which are sporadically connected by irregular shoots. The Martin Limestone is the host for the replacement bodies which are discontinuous tabular pods dipping parallel to the bedding. Selective

permeability is the ore control, caused by local hydrothermal solution of limestone and by deformation along faults. Copper is the chief metal.—*from* Authors' abstract

Hanson, Robert F. *See* Keller, W. D. 05567

05602 **Hardaway, John E.** Possibilities for subsurface waste disposal in a structural syncline in Pennsylvania, *in* Subsurface disposal in geologic basins—A study of reservoir strata: Am. Assoc. Petroleum Geologists Mem. 10, p. 93–127, illus., tables, 1968.

The bowl-shaped syncline forms a basin north of Bedford on the western perimeter of the Appalachians, and has sufficient closure to act as a reservoir. Total thickness of Paleozoic strata is more than 7,000 feet. The Lower Silurian Tuscarora Sandstone, a clean quartzose sandstone considered for waste disposal, outcrops along two-thirds of the syncline's perimeter and is about 3,700 feet beneath the center; it is not faulted and may be treated as a confined aquifer. Porosity measurements of Tuscarora and Juniata sandstones gave values of 15 and 10 percent respectively. Shale beds in the area are regarded as favorable for injection, into artificially made fractures, of wastes in cement slurries; but grouting in shale appears less promising than disposal in permeable sandstone.—*from* Author's abstract

05718 **Hardin, George C., Jr.; Mygdal, Karl.** Geologic success and economic failure: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 11, pt. 1, p. 2079–2091, illus., tables, 1968.

Economic success generally is measured by rate of return on invested capital and by total profit related to investment. In addition to direct costs, the cost of money or capital and the cost of taxes are two very important factors affecting economic success, and must be considered in appraising a [geologic] venture.—*from* Authors' abstract

05635 **Hardy, Richard.** Geology of Chefs Lake area, New Quebec [also French edition]: Quebec Dept. Nat. Resources Prelim. Rept. 574, 14 p., tables, geol. map, 1968.

All consolidated rocks in the Chefs Lake area are Precambrian. Quartzofeldspathic gneiss with inclusions of amphibolite and cut by pegmatite and amphibolite dikes underlies most of the eastern and western sections; bedrock of the central part is sedimentary and volcanic, intruded by sills of metagabbro and serpentinite. All rocks have been slightly metamorphosed with the exception of a gabbro in the axis of the major structural feature, a south-plunging syncline. A few minor faults were noted. Resources of economic interest are iron, and possibly pyrite and pyrrhotite.—MCM

Hare, Edward H., Jr. *See* Brockie, Douglas C. 05407

05478 **Harington, C. R.** A Pleistocene muskox (*Symbos*) from Dease Lake, British Columbia: Canadian Jour. Earth Sci., v. 5, no. 5, p. 1161–1165, illus., table, 1968.

A *Symbos* skull fragment from Pleistocene deposits of northern British Columbia constitutes the first record of that genus for the province. In Canada, remains of this large muskox have been collected previously in western Yukon and southeastern Saskatchewan. Most of the other known specimens have been found in Alaska and the central United States, and the Canadian occurrences help to link these two areas of *Symbos* range. *Symbos* was adapted to warmer surroundings than *Ovibos*—perhaps a steppe or parkland environment.—Author's abstract

Harms, T. F. *See* Nakagawa, H. M. 05196

05394 **Harshman, E. N.** Uranium deposits of Wyoming and South Dakota, *in* Ore deposits of the United States, 1933–1967 (Graton-Sales Volume), V. 1: New York, Am. Inst. Mining, Metall. and Petroleum Engineers, p. 815–831, illus., tables, 1968.

The major uranium deposits of Wyoming and South Dakota are in structural and/or erosional basins or on the flanks of uplifts. The principal host rocks are medium- to coarse-grained sandstones that were deposited in a continental or brackish water

environment and were derived in large part from the granitic cores of the uplifts and the sedimentary rocks that flank the cores. Over 95 percent of the host rocks are Eocene in age, and the bulk of the ore is unoxidized and lies below the water table. The ore is pyrite, uraninite and/or coffinite, marcasite, hematite, jordisite, and selenium. The deposits are in the form of ore rolls at the margins of tabular bodies of sandstone that have been altered by the ore-bearing solutions. The deposits are the result of interaction of an alkaline, oxidizing, ore-bearing ground water and a reducing environment.—*from* Author's abstract

05397 **Harshman, E. N.** Uranium deposits of the Shirley Basin, Wyoming, *in* Ore deposits of the United States, 1933–1967 (Graton–Sales Volume), V. 1: New York, Am. Inst. Mining, Metall. and Petroleum Engineers, p. 849–856, illus., 1968.

The Eocene Wind River Formation is the host rock for large, high-grade deposits in Shirley Basin. The major deposits are in sandstones that were deposited in stream channels and that were lithologically favorable for uranium accumulation; paleotopography influenced the character and position of the deposition. The major deposits are at or near margins of large tongues of altered sandstone formed in the most transmissive parts of thick sandstone beds; at least two tongues of such sandstone are present. The ore mineral is uraninite. Deposition is believed to have taken place when neutral to slightly alkaline, oxidizing, uranium-bearing ground water, on entering the basin, encountered a reducing environment, possibly H_2S of biogenic origin.—*from* Author's abstract

05395 **Hart, Olin M.** Uranium in the Black Hills, *in* Ore deposits of the United States, 1933–1967 (Graton–Sales Volume), V. 1: New York, Am. Inst. Mining, Metall. and Petroleum Engineers, p. 832–837, illus., table, 1968.

Uranium ores occur in the Inyan Kara group of heterogeneously stratified fluvial and fluvial–marine sandstones in the Black Hills. Primary minerals in the deposits are coffinite and uraninite with minor amounts of paramontroseite and haggite. The ore minerals coat sand grains and fill interstices of complexly cross-stratified sandstone along solution fronts similar to the "roll" type deposits of the other districts. Ground water was the transporting medium and deposition of primary uranium and vanadium minerals occurred in reducing environments produced and controlled by physiochemical characteristics of the sedimentary rocks.—*from* Author's abstract

Hart, Owen J. *See* Rubright, R. D. 05483

05330 **Hart, R. C.; Sprague, D.** Methods of calculating ore reserves in the Elliot Lake camp, *in* Ore reserve estimation and grade control—Canadian Centennial Conf., Quebec, 1967: Canadian Inst. Mining and Metallurgy Spec. Vol. 9, p. 251–260, illus., table, 1968.

The geological settings of the area are outlined, with particular emphasis on descriptions of the uraniferous quartz-pebble conglomerates, including their characteristics, trends, correlation and limits. Calculation factors, which include dilution, cut-off grades, mill tailings loss and stoping recovery percentages under varying mining conditions, are discussed. Also reviewed are underground development sampling, stope sampling and surface diamond drilling procedures. Methods used in calculating proven, probable, indicated and possible reserves, and definitions of these reserve categories, are presented, together with a comparison of forecast grades and tonnages and actual recoveries achieved.—Authors' abstract

Hartshorn, J. H. *See* Koteff, Carl. 05753

05517 **Hartung, Jack Burdair.** Application of the potassium–argon method to the dating of shocked rocks [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 29, no. 5, p. 1729B, 1968.

05183 **Hatch, Norman L., Jr.** Isoclinal folding indicated by primary sedimentary structures in western Massachusetts, *in* Geological Survey research 1968, Chap. D: U.S. Geol. Survey Prof. Paper 600–D, p. D108–D114, illus., 1968.

Regionally metamorphosed lower Paleozoic stratified rocks in the east limb of the Berkshire anticlinorium in western Massachusetts were affected by several stages of folding, one of which resulted in major isoclinal folds. The geometry of these isoclinal folds locally can be deduced from the map pattern of thin subunits and from abundant sedimentary structures that indicate tops of beds. Wavelengths of 200 to 1,000 feet are measured where the rocks involved are phyllites and schists; wavelengths of 2,000 feet are common where thicker bedded, more quartzose rocks are folded. Later folds, though widespread, are all small and apparently do not affect mapped contacts.—Author's abstract

Hathaway, D. J. *See* Ensign, C. O., Jr. 05409

05692 **Hattin, Donald E.** *Plesiacanthoceras wyomingense* (Reagen) from Graneros Shale and Greenhorn Limestone (Upper Cretaceous) of central Kansas: Jour. Paleontology, v. 42, no. 4, p. 1084–1090, illus., 1968.

Two specimens of the above species were uncovered during excavation at the Glen Elder damsite in a layer of septarian limestone concretions 3.1 feet below the base of the Lincoln Member of the Greenhorn Limestone. The zone of concretions lies within the interval of calcareous to chalky shale, transitional between typical Graneros Shale and typical Lincoln Limestone lithologies. This is part of the section that farther south is cut out by disconformity at the Graneros–Lincoln contact. The Glen Elder section represents uninterrupted deposition, and the zone of *P. wyomingense* is represented in normal position, as is predictable in a conformable succession of marine rocks.—JP

05484 **Hausen, Donald M.; Kerr, Paul F.** Fine gold occurrence at Carlin, Nevada, *in* Ore deposits of the United States, 1933–1967 (Graton–Sales Volume), V. 1: New York, Am. Inst. Mining, Metall. and Petroleum Engineers, p. 908–940, illus., tables, 1968.

Fine colloidal gold is disseminated in leached carbonate strata of the Roberts Mountain Formation in the Lynn "window" of the Roberts Mountain thrust fault. The ore body is generally stratiform and is more or less conformable to the altered beds near the top of the formation. Two sequences of mineralization are recognized: an earlier base-metal barite assemblage related to early Cretaceous intrusives, and a later low temperature Au–As–Hg–Sb assemblage of near-surface emplacement. The earlier sequence of sparse galena and sphalerite in barite is of little economic importance; gold is important in the second. Argillic alteration of hydrothermally leached carbonate strata has provided the environment for the gold deposition, a late stage epithermal mineralization.—*from* Authors' abstract

05333 **Havlena, D.** Dynamic reservoir data—Pt. 2, Interpretation, averaging and use of the basic geological-engineering data: Jour. Canadian Petroleum Technology, v. 7, no. 3, p. 128–144, illus., tables, 1968.

The purpose of this paper and of Pt. 1—Static reservoir data (ibid., v. 5, no. 4, 1966) is to emphasize that taking, assembling and averaging of the basic data for further use in an analysis of a reservoir requires profound knowledge of many of the specialized disciplines of modern geology and petroleum engineering. Dynamic reservoir data, here presented, can be used to investigate the level of energy, potential and also forces contained or induced into the reservoir. Methods of taking, recording and using the correct reservoir pressures and PVT are outlined, with discussion of a few specific cases which have complex problems. Disregarding the physical and mathematical accuracy of the analytical methods, the answers will be only as good as the degree in which basic data represents actual reservoir conditions in-situ.—GDC

05261 **Hawkins, James W., Jr.** Regional metamorphism, metasomatism, and partial fusion in the northwestern part of the Okanogan Range, Washington: Geol. Soc. America Bull., v. 79, no. 12, p. 1785–1819, illus., tables, geol. map, 1968.

The northwestern Okanogan Range comprises gneiss, schist, hornfels, and amphibolite, plus igneous rocks ranging from quartz diorite to quartz monzonite. Metamorphic mineral assemblages indicate more or less uniform metamorphism

under conditions equivalent to the cordierite–amphibolite facies with local transition to granulite facies. A cycle of synkinematic metamorphism was followed by a cycle of static recrystallization in essentially the same P–T field. The igneous rocks include an intrusive granodioritic pluton about 94.0 m.y. in age, and older leucocratic rocks. The older series includes gneissic syntectonic intrusives, and directionless late- to post-tectonic rocks that lack intrusive contacts. The latter are interpreted as anatectites formed during regional metamorphism. The rocks of the Okanogan Range may have formed by nearly isochemical metamorphism of eugeosynclinal sedimentary and volcanic rocks.—*from* Author's abstract

Hazel, Joseph E. *See* Gibson, Thomas G. 05234

05693 **Hazel, Joseph E.** Pleistocene ostracode zoogeography in Atlantic coast submarine canyons: Jour. Paleontology, v. 42, no. 5, p. 1264–1271, illus., tables, 1968.

Twenty-five rock samples dredged from ten submarine canyons off the Atlantic coast of the United States have yielded [more than 50 species of] ostracodes that are interpreted to be of Pleistocene age. The taxonomic composition of the assemblages [in comparison with modern faunas] suggests that during times of lowered sea level the present boundary between cold- and mild-temperate faunal provinces, about 42° north latitude, lay approximately 500 miles southwest, near 38° north latitude.—Author's abstract

05224 **Hazen, Scott W., Jr.** Ore reserve calculations, *in* Ore reserve estimation and grade control—Canadian Centennial Conf., Quebec, 1967: Canadian Inst. Mining and Metallurgy Spec. Vol. 9, p. 11–32, illus., tables, 1968.

Various methods of calculating ore reserves and inherent problems in the use of each method are discussed. Several samples are given to show how the amount of information on a deposit can be increased by using statistical techniques for calculating ore reserves. A method for using probability models as a basis for making decisions during mineral deposit exploration is presented. Some notes are given on problems encountered in using the statistical analysis of products (grade times sample interval) for weighted average grades. The problem of density contrast and its effect on the conversion from volume-percent to weight-percent is examined.—Author's abstract

Healy, J. H. *See* Borcherdt, R. D. 05462

Heath, Stanley A. *See* Kesler, Stephen E. 05338

05328 **Heim, R. C.** A comparison between ore reserve calculations and production at North Coldstream Mines Limited, *in* Ore reserve estimation and grade control—Canadian Centennial Conf., Quebec, 1967: Canadian Inst. Mining and Metallurgy Spec. Vol. 9, p. 172–176, illus., tables, 1968.

At North Coldstream Mines Ltd. [Ontario], 2,500,000 tons of ore, grading 1.97 percent copper, were mined and milled from 1960 until the mine was exhausted in 1967. The copper mineral was chalcopyrite, accompanied by pyrite; it occurred as fracture fillings and disseminations in chert in 15 lenticular orebodies of widely varying size. A comparison is made between ore estimates calculated during the mine's life and the actual production. Estimated tonnage was too low and estimated grade too high; some reasons for these errors are suggested.—*from* Author's abstract

05175 **Helley, Edward J.; LaMarche, Valmore C., Jr.** December 1964, a 400-year flood in northern California, *in* Geological Survey research 1968, Chap. D: U.S. Geol. Survey Prof. Paper 600-D, p. D34–D37, illus., 1968.

Twice in the past 13 years, recordbreaking floods have occurred over large areas of northern California. The true long-term recurrence intervals of these destructive floods is difficult to estimate by conventional flood-frequency analysis because prediction of a given flood discharge is based on historical records of flood peaks. Geomorphic and botanical evidence of a major prehistoric flood has been investigated on Blue Creek, a tributary to the Klamath River in northern California.

Radiocarbon analysis, supplemented by tree-ring counts, established a date about 400 years ago of a flood event that had approximately the same order of magnitude as the devastating floods of December 1964.—Authors' abstract

00040 **Helmberger, Donald V.; Morris, Gerald B.** A travel time and amplitude interpretation of a marine refraction profile—Primary waves: Jour. Geophys. Research, v. 74, no. 2, p. 483–494, illus., 1969.

Oceanic refraction surveys are interpreted almost exclusively on a time basis yielding layered crustal models. This study utilized more of the observed information by requiring the model to produce similar waveforms as well as traveltimes. Theoretical seismograms based on possible traveltime models are compared with the first few seconds of observed recording. Closely spaced comparisons are made along a 120-km profile located north of the Hawaiian Islands. The final model indicates: (1) a high positive velocity gradient in the upper layers above the main oceanic layer, (2) a relatively homogeneous oceanic layer with a sharp velocity discontinuity at the crust-mantle interface and (3) a small positive velocity gradient in the upper mantle.—Authors' abstract

Henderson, Bonnie C. *See* Downs, George R. 05241

Henderson, J. F. *See* Stockwell, C. H. 05654

Hendricks, Thomas A. *See* Haley, Boyd R. 05451

05575 **Henry, Gary E.** Recent developments in the Marietta Basin: Shale Shaker, v. 19, no. 3, p. 46–51, illus., 1968.

The Marietta basin, in Love and Marshall Counties, Okla., and Cooke and Grayson Counties, Tex., is one of three major structural subdivisions of the Amarillo-Wichita-Red River uplift. The most important oil fields produce from the Oil Creek sandstone (Ordovician) of the Criner Hills anticlinorium on the north. An excellent potential for additional fields is along their southeast extended trend and in fault blocks on the south side of the basin, in Texas. Significant discoveries of the last ten years which have not been discussed in other publications are described briefly. Subsurface structure, illustrated in the Handy, Bob K, and New Mag fields, may furnish leads for definition of prospects by geophysics. The basin margins with their rapid wedge-outs of Pennsylvanian clastic sequences likewise await further evaluation.—GDC

05435 **Henry, Vernon J., Jr.; Hoyt, John H.** Quaternary paralic and shelf sediments of Georgia: Southeastern Geology, v. 9, no. 4, p. 195–214, illus., 1968.

Pleistocene deposits associated with former high stands of the sea along the Georgia coast have not been transgressed and so retain characteristic sedimentological and morphological relationships of the modern coast. Holocene paralic deposits form a lens 20–30 miles wide that straddles the shoreline. A sediment thickness of over 100 feet occurs along the shoreline and is associated with inlet processes. Recent deposits of fine- to very fine-grained sand thin to a featheredge 10–15 miles seaward in 40–50 feet of water. Farther seaward the shelf is covered by coarse-grained, relict Pleistocene sediments. Inland from the shoreline, sediments are fine-grained barrier sand, and mixed sand, silt, and clay of salt marsh-filled lagoons. Sand from subjacent barrier and mainland sediments is incorporated into channel deposits.—*from* Authors' abstract

Heppting, L. M. *See* Chao, T. T. 05171

Heppting, L. M. *See* Chao, T. T. 05172

05296 **Hermes, O. Don.** Petrology of the Mecklenburg gabbro-metagabbro complex, North Carolina: Contr. Mineralogy and Petrology, v. 18, no. 3, p. 270–294, illus., tables, 1968.

The complex consists of metagabbro and metafelsic rocks of upper amphibolite grade, and a post-metamorphic gabbro. The younger gabbro is a plug-like body

with steep contacts and may extend only 8,000 to 15,000 feet into the subsurface. The mineralogy of the rocks is described. Hydrous minerals are abundant in the gabbro (up to 37 percent of the rock), and indicate that the fugacity of H_2O was relatively high during the crystallization. The metagabbro lacks olivine and contains relict igneous and crystalloblastic textures representing zones of mineral equilibrium. In general, metagabbro is higher in TiO_2, NaO, and K_2O, and lower in MgO relative to gabbro; regardless of the degree of recrystallization, the chemistry of the various metagabbro types is nearly identical, thus indicating that the metamorphism was essentially isochemical.—*from* Author's abstract

05382 **Hernon, Robert M.; Jones, William R.** Ore deposits of the Central mining district, Grant County, New Mexico, *in* Ore deposits of the United States, 1933–1967 (Graton–Sales Volume), V. 2: New York, Am. Inst. Mining, Metall. and Petroleum Engineers, p. 1211–1237, illus., table, 1968.

The Central district is unique in its juxtaposition of three classic types of ore deposits—porphyry copper, pyrometasomatic iron and zinc, and zinc–lead veins—that are clustered around three granitic stocks. The Santa Rita stock and adjacent sedimentary rocks form the host for chalcopyrite and pyrite disseminations and veinlets; supergene enrichment by chalcocite has formed the Chino deposit. The Hanover–Fierro stock, having replaced folded limestone and dolomite with tabular bodies of magnetite (north end) and sphalerite (south end), is accompanied by pyrometasomatic calc-silicates. Sphalerite veins with varying amounts of lead, copper, and silver extend southwesterly from the two major stocks, the principal veins occupying fractures in sills in Cretaceous sediments. The three types are products of a single hypogene metallization epoch early in the Tertiary.—*from* Authors' abstract

05534 **Hershey, Robert E.** Mineral resources summary of the Chesterfield quadrangle, Tennessee: Nashville, Tenn., Tennessee Div. Geology, 18 p., tables, 1968.

Of the 25 sand pits in the Chesterfield quadrangle, seven were active at the time of this investigation. Sand is found almost everywhere, but the better quality for more varied uses is in the McNairy Sand which crops out widely in all upland areas and contains a small percentage of heavy-mineral grains interspersed with quartz sand. This text accompanies Tennessee Div. Geology Geol. Map GM 11-NE by E. E. Russell (cited separately).—MCM

05518 **Hester, Norman Curtis.** The origin of the Cusseta Sand [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 29, no. 5, p. 1729B–1730B, 1968.

05662 **Hewitt, D. F.** Geology of Madoc Township and the north part of Huntingdon Township, Hastings County: Ontario Dept. Mines Geol. Rept. 73, 45 p., illus., tables, geol. map, 1968.

Physiographically the map area is divided into two parts by the Paleozoic–Precambrian contact running along the south side of Moira Lake. The area to the south is underlain by Ordovician limestone. In the northern part, grey-blue fine-grained marble overlies the oldest Precambrian rocks, the Tudor volcanics; to the southeast, conglomerate, argillite, and pelitic and psammo-pelitic schists overlie the volcanics. West of the town of Madoc, the andesitic to rhyolitic Madoc volcanics occupy a domical area about 9 sq. mi. Intruding the volcanics and metasediments are Deloro granite, Moira granite, Gawley Creek syenite, and Mount Moriah syenite. The rocks are folded and faulted, principal folds being the northwest trending Queensborough syncline and the northeast-trending Madoc syncline. Talc and marble are the main mineral products.—*from* Author's abstract

05482 **Hewitt, William Paxton.** Western Utah, eastern and central Nevada, *in* Ore deposits of the United States, 1933–1967 (Graton–Sales Volume), V. 1: New York, Am. Inst. Mining, Metall. and Petroleum Engineers, p. 857–885, illus., tables, 1968.

The area's greatest producers of metallic wealth are base-metal deposits in limestones and porphyry-type copper ores. The gold ores are frequently associated with realgar, cinnabar, and carbon. The ore deposits are generally attributed to Tertiary intrusives, but at Mountain City they may be related to Paleozoic volcanism.

Regional structure and stratigraphy are hard to evaluate as 69 percent of the area is obscured by alluvium or volcanics. Precambrian exposures, 3 percent of the area, are not important hosts. Sixteen precious metal deposits, six limestone replacement deposits, two silver–base metal deposits, and nine miscellaneous type deposits are described briefly.—*from* Author's abstract

05408 **Heyl, Allen V.** The Upper Mississippi Valley base–metal district, *in* Ore deposits of the United States, 1933–1967 (Graton–Sales Volume), V. 1: New York, Am. Inst. Mining, Metall. and Petroleum Engineers, p. 431–459, illus., tables, 1968.

Ores are chiefly in the Galena Dolomite and in limestones and dolomites of the Decorah and Platteville Formations, all Ordovician. Zinc–lead deposits are commonly linear, arcuate, or elliptical in plan. Most ore occurs as vein fillings in fractures and as breccia fillings and lining vugs, but some is in bedded replacements and impregnations of wall rocks. The primary minerals are quartz, illite, dolomite, pyrite, marcasite, cobaltite, sphalerite, galena, chalcopyrite, millerite, barite, and calcite. Sulfides are directly replaced by supergene minerals above the water table at 50 to 100 feet in depth; smithsonite is in pseudomorphs after sphalerite. Ore genesis is postulated by rising hot–water solutions—a mixture of heated connate, magmatic, and meteoric waters.—*from* Author's abstract

Heyman, Louis. *See* Lytle, William S. 05727

05245 **Hill, Mason L.** Geological revolution of the '60s: Geotimes, v. 13, no. 7, p. 10–12, 1968.

Accelerated oceanographic work in marine geology and geophysics has forced a new stage in the study of the Earth. Recent advances in remote–sensing technology have played a large part. With critical new data such as deep–sea cores and cooperation between marine and continental geologists and geophysicists, knowledge of Earth history will be expanded rapidly. It is up to conventional field geologists to assimilate these new data and concepts and to cooperate with oceanographers in unraveling and developing more of the mysteries of geology; by reading to catch up on the new geologic hypotheses, and by meditation to develop concepts, or tests of concepts, to contribute to the present revolution in geology.—GDC

05750 **Hitchon, Brian.** Rock volume and pore volume data for plains region of western Canada sedimentary basin between latitudes 49° and 60° N.: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 12, p. 2318–2323, illus., tables, 1968.

Volumes of sandstone, shale, carbonate rocks, and evaporite, and pore volumes within each of these, have been computed for 28 stratigraphic units in the plains region of western Canada. This region covers 486,785 sq mi and contains a total sedimentary fill of 537,895 cu mi, with an average depth of 5,834 feet. Tertiary strata comprise 1.3 percent, Mesozoic strata 45.5 percent, and Paleozoic strata 53.2 percent of the basin fill. The average lithologic percentages for the basin are: sandstone, 11.0; shale, 56.9; carbonate, 26.4; and evaporite, 5.7. The average basin porosity is 11.8 percent, with more than half the pore volume in Mesozoic shale which comprises only 38 percent of the total fill. The average basin porosity for sandstone, shale, and carbonate is 15.7, 13.9, and 8.2 percent, respectively.—*from* Author's abstract

Hoagland, Alan D. *See* Crawford, Johnson. 05416

Hoare, Joseph M. *See* Patton, William W., Jr. 05187

Hoare, Richard D. *See* Sturgeon, Myron T. 05643

05346 **Hobbs, S. Warren; Fryklund, Verne C., Jr.** The Coeur d'Alene district, Idaho, *in* Ore deposits of the United States, 1933–1967 (Graton–Sales Volume), V. 2: New York, Am. Inst. Mining, Metall. and Petroleum Engineers, p. 1417–1435, illus., tables, 1968.

The country rock comprises six formations in the Belt Series which have been intruded by small monzonitic stocks. The district structure is complicated and

comprises folds, some of which are overturned, and a complex of faults of diverse ages and directions. Ore occurs in a series of steeply dipping replacement veins of relatively simple mineralogy. Six periods of mineralization, from Precambrian to Tertiary, are recorded. The productive galena–sphalerite veins and tetrahedrite-bearing veins of the main period of mineralization, are younger than the Late Cretaceous stocks, but are also probably Cretaceous in age. The productive veins localized in belts controlled by deep fractures in the basement. Bedding attitude, brittleness of rocks, and amount and direction of fault movement seem to be the ore controls.—*from* Authors' abstract

05350 **Hobbs, S. Warren.** Geologic setting of metallic ore deposits in the northern Rocky Mountains and adjacent areas, *in* Ore deposits of the United States, 1933-1967 (Graton-Sales Volume), V. 2: New York, Am. Inst. Mining, Metall. and Petroleum Engineers, p. 1351–1372, illus., table, 1968.

The section of the northwestern United States that includes the northern Rocky Mountains and adjacent areas to the west and east is one of large mineral production and important mineral potential. The metallic ore deposits vary widely in age and type and their geologic settings are similarly diverse. A brief resume of the region's physiographic characteristics and geology sets the framework for the selected ore deposits described in the following papers and makes it possible to place these ore deposits in their proper reference to space and time.—Author's abstract

05242 **Hoffman, Douglas W.** Soil development and land use on Manitoulin Island, *in* The geology of Manitoulin Island—Michigan Basin Geol. Soc., Ann. Field Excursion, 1968: [Lansing, Mich., Michigan Geol. Survey] p. 79–86, illus., 1968.

This paper briefly describes the soils of Manitoulin Island and some of the factors that influenced their development. Almost two-thirds of the island is made up of thin Brown Forest soils. These have 12 inches or less of soil overlying limestone, dolomite, or shale bedrock. The remainder consists of deep soils, many of which are considered to be Dark Grey Wooded. Gray Brown Podzolic, Humic Greysol, Regosol, and Organic soils are also present. The deep soils provide the greatest potential for agriculture, and the best of these are located south of Lakes Kagawong and Mindemoya, west of Gore Bay, on Barrie Island and around Manitowaning.—Author's abstract

Hoffman, Victor J. *See* Gray, Raymond F. 05359

Holland, H. D. *See* Gammon, J. B. 00034

05648 **Horn, Elizabeth Mueller.** Ecology of the Pumice Desert, Crater Lake National Park: Northwest Sci., v. 42, no. 4, p. 141–147, illus., tables, 1968.

The Pumice Desert, a 5 1/2 sq mi area, is a real desert, with a low density of plants, each species of which possesses one or more morphological adaptations for survival. Widely fluctuating temperatures and high atmospheric evaporation are characteristic, with surface soils heating to 20°F or more above air temperatures on sunny days. Oregon pumice soils are generally considered infertile, but soils here are even less developed than is usual. Soil moisture does not appear to be a major limiting factor in slowing plant invasion. Mechanical analyses of Crater Lake pumice soils made by Tidball compared with those made by the author suggest the Pumice Desert soils have a more youthful structure than those developed elsewhere from Mount Mazama pumice.—MST

Horn, M. K. *See* Manheim, F. T. 05436

05724 **Hoskin, Charles M.** Magnesium and strontium in mud fraction of Recent carbonate sediment, Alacrán Reef, Mexico: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 11, pt. 1, p. 2170–2177, illus., tables, 1968.

Magnesium and strontium were found as minor elements in 74 carbonate mud fractions analyzed by atomic absorption spectrophotometer. Statistically significant differences in mean magnesium and strontium content exist for four of five mud-accumulating environments. Maximum magnesium (mean $1.3\& \times 10^4$ ppm) was

found in the moat adjacent to magnesium-rich coralline algae sediment; maximum strontium (mean 0.58×10^4 ppm) was found in cellular reef deeps adjacent to strontium-rich stony corals and codiacean algae. Origin of these mud fractions is believed to be comminuted carbonate skeletons.—*from* Author's abstract

05726 **Hoskins, E. R.** Strain rosette relief measurements in hemispherically ended boreholes: Internat. Jour. Rock Mechanics and Mining Sci., v. 5, no. 6, p. 551–559, illus., 1968.

Full-scale laboratory experiments have been performed to determine the effectiveness of strain rosette relief techniques in hemispherically ended boreholes. Strains measured during these tests agree with those inferred from the well-known solution for the stresses surrounding a spherical cavity in an elastic medium. If the orientation of the stress field is known or assumed, and the borehole is drilled parallel to one of the principal stress directions, and the magnitude of the stress acting parallel to the borehole is taken into account, strain relief in hemispherically ended boreholes appears to be a promising technique for measuring rock stress.—Author's abstract

05198 **Hostetler, P. B.; Christ, C. L.** A temperature-controlled water bath for mineral solubility studies, *in* Geological Survey research 1968, Chap. D: U.S. Geol. Survey Prof. Paper 600-D, p. D217–D221, illus., 1968.

The design of a temperature-controlled water bath for study of mineral phase equilibria in aqueous media is described. The bath consists of a polypropylene cylinder in which five polypropylene reaction vessels, providing a silica-free environment, are suspended. Temperatures ranging from 0°C to 95°C (at 1 atmosphere total pressure) can be maintained at approximately ±0.4°C for periods of months. Provision is made for sweeping a selected gas through the contents of any of the reaction vessels.—Authors' abstract

05665 **Hotton, Nicholas, 3d.** The evidence of evolution: New York, Am. Heritage Publishing Co. (in association with Smithsonian Inst.), 160 p., illus., 1968.

This book is one of a series on science and technology written for the layman and published in collaboration with the Smithsonian Institution. Modern evolutionary theory is explained and its history is summarized. Evolution as a life process is exemplified by variants of well-known living forms. Chapters on fossil forms treat the fossil record; transition of organisms from sea to fresh water, and from water to land; and evolution of higher vertebrates on land, including origin and extinction of dinosaurs and rise of the mammals. Illustrations in color include portions of the Smithsonian murals depicting restorations of North American Tertiary and Pleistocene mammals. The appendix includes biographical sketches of 15 theorists, excerpts from Darwin's "Voyage of the Beagle," and a reading list.—VMJ

05748 **Houston, Robert S.** Horace Davis Thomas (1905–1967): Am. Assoc. Petroleum Geologists Bull., v. 52, no. 12, p. 2503–2504, portrait, 1968.

05236 **Howard, J. H.** Recent deformation at Buena Vista Hills, California: Am. Jour. Sci., v. 266, no. 9, p. 737–757, illus., tables, 1968.

Horizontal displacement of surveyed points during 1932–1959 have been analyzed to determine strains. The east-west trending, north-dipping Buena Vista Hills thrust fault divides the area. The direction of greatest contraction trends generally normal to the fault near it on the north block; elsewhere this component tends to parallel the trace. Magnitudes of principal strains vary spatially from 300×10^{-6} to 5000×10^{-6}. An east-west zone of contractive dilatation exists about the thrust trace. Field observations compatible with this geodetic data are given. Overthrusting and underthrusting have occurred at the east end of the trace. On the west, however, both blocks are moving north, but the south block has moved more. The method applies only to two-dimensional problems; the data are Cartesian components of a limited number of points.—*from* Author's abstract

05209 **Howard, Keith A.** Flow direction in triclinic folded rocks: Am. Jour. Sci., v. 266, no. 9, p. 758–765, illus., 1968.

Folds that have widely dispersed trends in outcrop of the northern Ruby Mountains, Nevada, show a common sense of overturning that is interpreted to be the flow line of velocity-gradient flow. The flow line thus deduced remains constant over a wide area in which both the major folds and the average parasitic folds vary markedly in orientation, and the fabric symmetry varies from monoclinic to triclinic.—Author's abstract

05590 **Howe, Robert H. L.** A comprehensive and economical method for the discovery and evaluation of water resources [with French and Spanish abs.]. *in* Water for peace—Internat. Conf., Washington, D.C., 1967—V. 4, Water supply technology: Washington, D.C., U.S. Govt. Printing Office, p. 952-962, illus., tables, 1968.

The suggested comprehensive and economical method for evaluation of water resources employs aerial analysis supported by studies of geology, ground formations, soils, vegetation, topography, land forms, land uses, climate, and hydrology of the watershed. All limiting factors (aquifers, data, conditions affecting movement and storage, and local factors) in ground-water investigations can be observed and identified on aerial photographs. By analyzing soil, vegetation, topography, land forms, land uses, geology, climatic data, etc., a water balance chart for the area can be produced. A ground-water inventory of Tipton County, Indiana, is used as an example.—MCM

Hoyer, Richard P. *See* Etter, Robert J. 05260

Hoyt, John H. *See* Henry, Vernon J., Jr. 05435

05633 **Hoyt, John H.** Genesis of sedimentary deposits along coasts of submergence. *in* Internat. Geol. Cong., 23d, Prague, 1968, Proc., Sec. 8, Genesis and classification of sedimentary rocks: Prague, Academia, p. 311-321, illus., 1968.

Marine and continental processes combine to concentrate sediment in the vicinity of the coast. The site of maximum deposition is related to "sedimentation factors", including sediment supply, slope of land and sea floor, and hydrodynamic conditions. Multiple submergences during the Quaternary provide natural models for the interpretation of submergence deposits in ancient sedimentary sequences. In coastal plain areas near large rivers, the major Quaternary deposits are associated with deltas. Away from the direct influence of continental detritus, the characteristic deposits are those associated with barrier islands, including lagoon-marsh, tidal channel, barrier, and near-shore neritic environments.—*from* Author's abstract

05519 **Hu, Chung-Hung.** Ontogeny and sexual dimorphism of lower Paleozoic Trilobita [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 29, no. 5, p. 1730B, 1968.

Hunt, R. N. *See* Nolan, T. B. 05486

05312 **Hymas, K. I.** A note on sampling at the Questa molybdenite mine. *in* Ore reserve estimation and grade control—Canadian Centennial Conf., Quebec, 1967: Canadian Inst. Mining and Metallurgy Spec. Vol. 9, p. 319-320, illus., 1968.

The Questa property is in the Sangre de Cristo Mts. of northern New Mexico. Narrow high-grade veins of molybdenite are emplaced in a fractured alaskite or monzonite, near an altered intrusive plug. When core drilling and wire-line techniques provided unreliable samples, a bulk sampling plant was built. Most of the core assays were below corresponding bulk values; possible correlation between the two is discussed. Later longhole and rotary drilling techniques produced satisfactory samples as proved by bulk sampling.—ESL

05459 **Idriss, I. M.; Seed, H. Bolton.** An analysis of ground motions during the 1957 San Francisco earthquake: Seismol. Soc. America Bull., v. 58, no. 6, p. 2013-2032, illus., tables, 1968.

The seismic responses of soil deposits are calculated at four sites where recordings were obtained during the 1957 San Francisco earthquake. The analyses are made utilizing an equivalent linear lumped-mass method of analysis incorporating the soil characteristics at the four sites and estimates of the rock motions at each site based

on the record obtained on rock during this earthquake. Comparisons of the maximum amplitudes of ground motions, the time history of ground accelerations, velocity and acceleration spectrums and spectral intensities for both computed and recorded ground accelerations indicate a reasonably high degree of agreement. The influence of the amplitude of base-rock accelerations on the response of a soil deposit is also discussed and illustrated.—Authors' abstract

05758 **Illinois State Geological Survey.** Geological science field trip, Princeton area, Bureau County, Annawan, Buda, Hennepin, and LaSalle quadrangles: Illinois Geol. Survey Guide Leaflet 1968E and 1969C, 37 p., illus., 1968.

In a summary of glacial history of Illinois, an illustratiion shows 12 stages including 3 soil intervals; the sand and gravel, rich soils, and ground water in glacial outwash are valuable resources. Topography and surficial materials in the Princeton area are predominantly Wisconsinan; thickest deposits are in a buried main channel of the Pleistocene Mississippi River. Kansan till and outwash, confined to bedrock valleys, are not exposed; Illinoian drift, extensive under the Wisconsinan, has scattered southwestern outcrops. Crossing a number of morainal fronts and areas of various glacial, lake, and delta deposits, this field trip makes stops where stratigraphic relationships can be seen. Upper Pennsylvanian limestones are the only bedrock exposures; fossils are illustrated. The Pennsylvanian rocks in the state, and coal no longer mined in this area, are discussed in some detail.—GDC

05774 **Illinois State Geological Survey.** Geological science field trip, Thebes area, Alexander County, Jonesboro and Thebes quadrangles: Illinois Geol. Survey Guide Leaflet 1968A and F, 35 p., illus., 1968.

The Thebes area, one of the few areas in Illinois where strata of Paleozoic, Mesozoic, and Cenozoic ages can be seen, lies on the northeast flank of the Ozark Dome and includes the northern edge of the Gulf Coastal Plain's Mississippi embayment. It is underlain by thousands of feet of strata in the Illinois basin, and is capped by glacial outwash deposits and loess. The various stratigraphic units, as seen in sections visited on this trip, are described briefly and their depositional relations are considered. Also discussed are paleosols, deposits of loess with enclosed snails by which it is dated, the Mississippi River drainage and its divergence through Thebes Gorge, a few normal faults, and some regional geology. A generalized geologic column, and reduced geologic map of Illinois are included, also line drawings to illustrate lithofacies, glaciation, and other features mentioned.—GDC

05855 **Illinois State Geological Survey.** Geological science field trip, Barry area, Pike and Adams Counties, Pittsfield, Liberty, Mt. Sterling, and Barry quadrangles: Illinois Geol. Survey Guide Leaflet 1968B, 35 p., illus., 1968.

The Barry area lies within the Lincoln Hills section of the Ozark Plateau, between the Mississippi and Illinois Rivers. Pleistocene ice left widespread but thin and patchy Kansan till and outwash, and thick Illinoian gravels, important as a mineral resource. Paleozoic strata in the underlying Illinois basin, about 3,000 feet thick, include limestone, sandstone, shale and coal beds of economic value. Quarries expose fossiliferous Mississippian limestone. Pennsylvanian cyclothems and the origin of coal are explained. A ridge of Late Cretaceous sands and gravels, the Baylis Formation, was formerly considered Pleistocene in age. Briefly discussed are the erosion of the Calhoun peneplain surface and deposition of Pleistocene soils, silts, and loess. Reduced geologic and glacial maps of the stage, a time table of Pleistocene glaciation and illustrations of fossils and other features are included.—GDC

05857 **Illinois State Geological Survey.** Geological science field trip, St. Elmo area, Fayette, Effingham, and Clay Counties, St. Elmo, Kinmundy, and Edgewood quadrangles: Illinois Geol. Survey Guide Leaflet 1968D, 43 p., illus., 1968.

In the St. Elmo area, south-central Illinois, Kansan till buried by Illinoian till and outwash comprises the upland surface, underlain by 9,000 feet of Paleozoic strata in the Illinois basin; only the upper 300 feet, Pennsylvanian, is exposed. The fossiliferous limestones of the Bond and Mattoon Formations and the Millersville are described; the latter is quarried for crushed stone, lime, and cement. Near the

crest of the Louden anticline is an important oil field. Oil production from the Mississippian Chester Series is not affected by storage of gas, from southern fields, in the deeper Devonian and older arched limestones. Sand and gravel are obtained from kames and outwash in ridged drift on the interlobate complex of the till plain. These ridges reveal the linearity of the southwestward meltwater drainage on a broad, Pleistocene eroded valley ancestral to the Kaskaskia River.—GDC

05547 **Imrie, A. S.** Analysis of the underground powerhouse arch at the Portage Mountain dam [abs.]: Bull. Canadian Petroleum Geology, v. 16, no. 3, p. 414, 1968.

05437 **Ingram, Roy L.** Vertical profiles of modern sediments along the North Carolina coast: Southeastern Geology, v. 9, no. 4, p. 237–244, illus., 1968.

Sediments now accumulating landward along the North Carolina coast are in one of four main depositional environments: barrier island, bar-built estuary, drowned estuary, and marsh. As sedimentation processes continue, characteristic vertical profiles will develop. In barrier bars are found laminated shelly fine to coarse beach sand; cross-bedded dune sand; massive fine sand leeward from the beach and dunes on beach ridges, aeolian flats, and vegetation areas; and massive highly organic, muddy marsh sands. Bar-built and drowned estuaries have similar sediment patterns—black, highly organic muds in deeper holes, and in small shallow bays marginal to larger estuaries. Deeper parts of the inlets through barrier islands and tidal channels from the inlets into the estuaries contain shelly coarse sand.—*from* Author's abstract

Irvine, W. T. *See* Swanson, C. O. 05227

Irving, Robert S. *See* Stuessy, Tod F. 05652

05571 **Isphording, Wayne C.; Lodding, William.** Origin of the Woodstown, New Jersey, macro-kaolinite [with French, German, and Russian abs.]: Clays and Clay Minerals, v. 16, no. 3, p. 257–264, illus., tables, 1968.

A kaolin bed in which many of the individual kaolinite platelets exceed 0.2 mm in size occurs in the immediate vicinity of the base of the middle-Miocene Kirkwood Formation, near Woodstown, N. J. These platelets appear to have resulted from breakdown of pre-existing illite and montmorillonite coupled with concurrent epitaxial growth and diagenetic growth of primary kaolinite. The alteration of the clay minerals is thought to be a product of upward leaching (dialysis) by ground waters in the underlying Vincentown Sand. This is further evidenced by abnormally high percentages of clay-size kaolinite in the clays that lie above the Vincentown Sand but beneath the macro-kaolinite horizon. Growth of the macro-kaolinite was facilitated by face-to-edge sedimentation and the resultant high permeability of the stratum.—Authors' abstract

05344 **Ito, Keisuke; Kennedy, George C.** Melting and phase relations in the plane tholeiite-lherzolite-nepheline basanite to 40 kilobars with geological implications: Contr. Mineralogy and Petrology, v. 19, no. 3, p. 177–211, illus., tables, 1968.

Picrite, olivine-rich tholeiite, nepheline basanite, alkali picrite, olivine-rich basanite, and olivine-rich alkali basalt were recrystallized at pressures to 40 kb. Picrite recrystallized along the solidus into several assemblages depending upon the pressure as did olivine-rich tholeiite; in the former, the primary phase crystallizing at all pressures is olivine; in the latter, it is olivine below 20 kb, orthopyroxene at 40 kb. Mineral assemblages in a granite-basalt-peridotite join are summarized according to reported experimental data. Compositions of minerals in natural granulite and eclogite facies rocks are considered. Temperatures near the bottom of the crust in orogenic zones characterized by kyanite-sillimanite metamorphism in Precambrian shields are estimated to be 700°C at 7 kb and 800°C at 9 kb.—*from* Authors' abstract

05557 **Izett, Glen A.** Geology of the Hot Sulphur Springs quadrangle, Grand County, Colorado: U.S. Geol. Survey Prof. Paper 586, 79 p., illus., tables, geol. map, 1968.

The quadrangle is underlain by Precambrian crystalline rocks, Mesozoic and Tertiary sedimentary rocks, Mesozoic(?) and Tertiary intrusive igneous rocks, and middle and upper Tertiary extrusive volcanic rocks. Deformed Precambrian high-rank biotite gneiss is cut by small plutons of granite, quartz monzonite, granodiorite, and biotite-quartz diorite. Mesozoic sedimentary rocks, 5,000 feet thick, are truncated by a thick sequence of basin-fill arkosic conglomerate of the Upper Cretaceous and lower Tertiary Middle Park Formation. Epiclastic breccia and conglomerate occur at the base of the Middle Park Formation. Tuffaceous Miocene sedimentary rocks, about 400 feet thick, mantle the older rocks and contain a large assemblage of fossil mammal remains. Mesozoic and Tertiary rocks were recurrently deformed and show evidence of two periods of Laramide and one period of post-Laramide tectonism.—GAI

05356 **Jackson, Everett D.** The chromite deposits of the Stillwater Complex, Montana, *in* Ore deposits of the United States, 1933–1967 (Graton-Sales Volume), V. 2: New York, Am. Inst. Mining, Metall. and Petroleum Engineers, p. 1495–1510, illus., tables, 1968.

Layered concentrations of chromite occur only within the olivine-rich layers of the Peridotite member of the Ultramafic zone of the Stillwater Complex. As many as thirteen chromite zones are known, but only five are of economic interest, and only two have been mined. Individual chromite zones can be distinguished by internal character and stratigraphic position. The thicknesses range from an inch to more than 12 feet and the Cr_2O_4 content varies from 36.6 to 49.2 weight percent. Laterally, the thickness of zones is related to thickness of the Peridotite member; in general all are thicker in the eastern part of the Stillwater than in the western part.—*from* Author's abstract

05636 **Jacoby, R. S.** Geology of Baskatong Reservoir area (west half) [also French edition]: Quebec Dept. Nat. Resources Prelim. Rept. 572, 11 p., table, geol. map, 1968.

The Baskatong Reservoir area lies in the Grenville province and all consolidated rocks are Precambrian. Major units include a quartz-diorite gneiss and a metasedimentary assemblage of biotite gneisses, marbles, and quartzite; all are injected to various degrees by a younger pink granite. Numerous, small diabase dikes are noted. With the exception of the pink granite and the diabase dikes, all rock units show evidence of folding, high-grade metamorphism, and in some cases, cataclasis. Foliation is well developed parallel to the primary sedimentary layering of rock units and to their contacts, the general direction being northeast. Joints are numerous, the two most important sets striking NE and NW. A possible resource is quartz crystal which lines abundant cavities in marble and biotite paragneisses.—MCM

05649 **Janssens, A.** Stratigraphy of Silurian and pre-Olentangy Devonian rocks of the South Birmingham Pool area, Erie and Lorain Counties, Ohio: Ohio Div. Geol. Survey Rept. Inv. 70, 20 p., illus., tables, 1968.

This investigation shows that rocks formerly placed in the undifferentiated Lockport Group in the report area can be subdivided and correlated with the Middle Silurian section of southwestern Ontario. One of these subdivisions, the Guelph Formation, has a biohermal facies which reaches a thickness of more than 90 feet. The interpretation is offered that the Detroit River Group, rather than having been truncated by the overlying Columbus Limestone, has a facies which is indistinguishable from the Columbus Limestone. Three potentially productive gas or oil zones occur in structural highs within the described section. The highest gas zone is within the Columbus Limestone, and the second in the Newburg zone, which lies immediately below the lowest anhydrite in the section. The third zone, which contains gas and rocks heavily stained with oil, is the biohermal facies of the Guelph Formation.—*from* Author's introduction

Jarosch, H. *See* Ben-Menahem, Ari. 05452

Jenne, E. A. *See* Chao, T. T. 05171

Jenne, E. A. *See* Chao, T. T. 05172

05706 **Johnson, J. G.** A new species of *Vagrania* (Devonian, Brachiopoda) from Nevada: Jour. Paleontology, v. 42, no. 5, p. 1200–1204, illus., table, 1968.

A new atrypid brachiopod species, *Vagrania gronbergi*, is described from beds of Eifelian age in central Nevada. It represents the first certain occurrence of *Vagrania* in the United States and is of interest because of its restricted provincial affinity, indicating communication around western and Arctic North America with faunas of the Urals and far-eastern Asia of the U.S.S.R.—Author's abstract

Johnson, J. G. *See* Boucot, A. J. 05707

Johnson, Philip L. *See* Likens, Gene E. 05332

Johnson, Rockne H. *See* Norris, Roger A. 00022

Jones, D. L. *See* Murthy, G. S. 05469

05582 **Jones, Michael L.; Clendening, John A.** A feasibility study for paleocurrent analysis in lutaceous Monongahela–Dunkard strata of the Appalachian basin: West Virginia Acad. Sci. Proc. 1968, v. 40, p. 255–261, illus., table, 1968.

A partially computerized statistical analysis of ostracode orientations for seven sample sites was conducted. The results indicate a general northerly direction of paleocurrent flow for Monongahela and Dunkard time.—Authors' abstract

Jones, William R. *See* Hernon, Robert M. 05382

Jonson, David C. *See* Wallace, Stewart R. 05400

05702 **Jorgensen, Donald G.** An aquifer test used to investigate a quality of water anomaly: Ground Water, v. 6, no. 6, p. 18–20, illus., table, 1968.

An aquifer test and analyses of water samples, showed that the anomalous water quality of a municipal well [Avon, S. Dak.] was caused by leakage from a nearby abandoned well tapping another aquifer.—Author's abstract

05563 **Jörgensen, Per.** Infrared study of water adsorbed on Wyoming bentonite: Geol. Fören. Stockholm Förh., v. 90, pt. 2, no. 533, p. 213–220, illus., 1968.

Infrared data for Na–Wyoming bentonite showed that the clay–ion system influenced the bending vibration for the water molecules as well as the amount of hydrogen bonds formed. The effects were very pronounced at low water concentrations. When the amount of water adsorbed on the clay surfaces corresponded to a monolayer between the silicate layers, optimum restrictions upon the bending vibrations were found. The amount of hydrogen bonding was also at a maximum here. The amount of hydrogen bonding was at a minimum for a water content corresponding to about two water layers. As the water content was increased above this value, there was a gradual increase in hydrogen bonding, and a decrease in bending vibration restrictions until the values for bulk water were reached. These results were explained in terms of water–ion and water–surface interaction.—Author's abstract

05223 **Kaas, L. Michael.** Computers in the mining industry, *in* Ore reserve estimation and grade control—Canadian Centennial Conf., Quebec, 1967: Canadian Inst. Mining and Metallurgy Spec. Vol. 9, p. 103–108, illus., 1968.

This paper describes computer systems and computer applications with special reference to those in use in the mining industry. The usage of such terms as "hardware" and "software" is explained in reference to the configuration of computer systems, with examples of applications. Cost of computer operations are discussed.—Author's abstract

05434 **Kalliokoski, J.** Structural features and some metallogenic patterns in the southern part of the Superior Province, Canada: Canadian Jour. Earth Sci., v. 5, no. 5, p. 1199–1208, illus., 1968.

In the Superior Province the Quetico belt of metasedimentary rocks extends from Minnesota across the Kapuskasing zone of crustal rifting, to southeast of James Bay, as part of a broader northeast-trending orogenic zone, truncating the more westerly fold trends in lavas and sediments of eastern Ontario and western Quebec. It is suggested that the Quetico trend is the younger, and demarcates the geographic limits of the Kenoran orogen. In western Quebec and eastern Ontario three granite-cored massifs are bounded on the north by curved, regional faults and synclinal belts of metasediments. The most important, the Pontiac Massif, is associated with a corresponding sediment-filled depression on the west. It is proposed that a broad region east and northeast of Lake Superior, containing many belts of iron formation, was formed in a restricted time period or restricted volcanic-sedimentary environment.—*from* Author's abstract

Kanasewich, E. R. *See* Robinson, J. E. 05618

05536 **Kaser, Rolland F.; Allison, Stephen V.** Use of modern equipment and techniques in the planning and development of water resources [with French and Spanish summ.], *in* Water for peace—Internat. Conf., Washington, D.C., 1967—V. 6, Planning and developing water programs: Washington, D.C., U.S. Govt. Printing Office, p.509–524, illus., table, 1968.

The increased demand for water in areas where supplies are already committed has created the need for improved techniques in planning and development of water resources. The planning process and its constraints lend themselves to solution by electronic equipment in spillway design flood analyses, water-yield studies, and operation studies by mathematical models and system simulation. Enough consulting firms are now equipped with proper facilities and experience to assist developing countries with their water problems without excessive cost.—MCM

Kasser, P. *See* Bauer, A. 05289

Keenan, Albert M. *See* Link, James M. 05728

05627 **Keller, G. H.; Bennett, R. H.** Mass physical properties of submarine sediments in the Atlantic and Pacific basins, *in* Internat. Geol. Cong., 23d, Prague, 1968, Proc., Sec. 8, Genesis and classification of sedimentary rocks: Prague, Academia, p. 33–50, illus., 1968.

Measurements of mass properties have been made on a large number of sediment cores representing several types of deep-sea sediment as well as different depositional environments within the Atlantic and Pacific basins. Some degree of correlation is found between these properties and sediment type, currents, and local topography. Portions of the Pacific sea floor consisting of "red clay" commonly display lower cohesion and bulk density, but higher water contents than those areas blanketed by calcareous oozes. Atlantic sediments are denser and stronger than those of the Pacific; such properties as water content and porosity are usually higher in the Pacific. In the vicinity of continental margins, mass physical properties vary considerably as the sediment supply and depositional environment change. Sediments from carbonate environments or areas of relatively high relief normally possess greater cohesion.—*from* Authors' abstract

05208 **Keller, George H.** Shear strength and other physical properties of sediments from some ocean basins, *in* Civil engineering in the oceans—ASCE Conf., San Francisco, Calif., 1967, Proc.: [New York] Am. Soc. Civil Engineers, p. 391–417, illus., 1968.

Measurement of mass physical properties—wet density, shear strength, water content, grain size—have been made on a large number of sediment cores collected from the North Atlantic and North Pacific Ocean basins; these samples represent types of deep-sea sediment and different depositonal environments. Some correlation is found between these properties and sediment type, currents, and local

topography. Areas of 'red clay' commonly display lower shear strengths and bulk densities than those blanketed by calcareous oozes; on continental margins mass physical properties vary considerably as sediment supply and depositional environment change. Sediments from carbonate environments or areas of relatively high relief have higher shear strengths.—*from* Author's abstract

05567 **Keller, W. D.; Hanson, Robert F.** Hydrothermal alteration of a rhyolite flow breccia near San Luis Potosí, Mexico, to refractory kaolin [with French, German, and Russian abs.]: Clays and Clay Minerals, v. 16, no. 3, p. 223–229, illus., tables, 1968.

A refractory kaolin clay deposit at the General Zaragosa Mine was formed by hydrothermal argillation of part of a fault block of rhyolite flow breccia and probably welded tuff. A silica-rich gossan caps the deposit. Optical, X-ray, DTA, and chemical studies show the following progressive sequence of alteration: (a) bleaching of the breccia matrix accompanied by mobilization of much of the iron; (b) mobilization of alkali and alkaline earth metals to form montmorillonite, and mobilization of silica to form disseminated quartz and periferal tripolitic rock; (c) further desilication of silica and clay to yield poorly ordered kaolinite-halloysite as the most intense end product of argillation; most of the silica was redeposited as opal and chalcedony in a gossan overlying the clay; (d) minor alunite at two places may mark the loci of the rising solutions.—Editor's abstract

05390 **Kelley, Vincent C.; Kittel, Dale F.; Melancon, Paul E.** Uranium deposits of the Grants region, *in* Ore deposits of the United States, 1933–1967 (Graton-Sales Volume), V. 1: New York, Am. Inst. Mining, Metall. and Petroleum Engineers, p. 747–769, illus., table, 1968.

Uranium occurs predominately in continental sandstones of the upper Morrison Formation but significant lesser deposits occur in the underlying Todilto Formation, and in black shale of the Dakota Formation. The deposits are disseminations that form runs ranging from a few hundred tons to several million tons. The ore is mainly uraninite, uraniferous carbonaceous material, coffinite, and numerous secondary minerals. In sandstone, the ore runs were localized by mudstone, interstitial carbonaceous material, and primary sand channel trends. In limestone, the ore is related to folds and fracture zones. The origin is not simple, but the original runs are probably pre-Dakota in age, and two stages of formation are recognized at Ambrosia Lake.—*from* Authors' abstract

05585 **Kellogg, Remington.** Fossil marine mammals from the Miocene Calvert Formation of Maryland and Virginia—Pt. 6, A hitherto unrecognized Calvert cetothere: U.S. Natl. Mus. Bull. 247, pts. 5–8, p. 133–161, illus., 1968.

In the course of detailed comparison of skulls, tympanic bullae, periotics, mandibles, vertebrae, and limb bones of Calvert cetotheriid mysticetes with those of Van Beneden's (1836–86) Belgian Miocene types, a new genus has been recognized. *Diorocetus hiatus*, n.gen., n.sp., is distinguished from all other cetotheriid genera by an elongated incisure that divides the posterior end of each maxillary into a dorsal and ventral plate. The type specimen includes an essentially complete skull, physically immature as is another nearly complete skull among the three referred specimens. Reliability of the mandibular condyle, periotic, and tympanic bulla as generic criteria is discussed briefly. Skeletal modifications now attributed to either growth or variability were given little consideration by Van Beneden.—VMJ

05586 **Kellogg, Remington.** Fossil marine mammals from the Miocene Calvert Formation of Maryland and Virginia—Pt. 7, A sharp-nosed cetothere from the Miocene Calvert: U.S. Natl. Mus. Bull. 247, pts. 5–8, p. 163–173, illus., 1968.

Although generic criteria for fossil mysticetes such as conformation of mandibular condyle may not be entirely reliable, it seems desirable to allocate a recognizably different specimen to a currently valid genus. *Aglaeocetus* was diagnosed by Kellogg (1934) for *Cetotherium moreni* Lydekker from the lower Miocene of Argentina. *Aglaeocetus patulus*, n.sp., from the middle Miocene Calvert, is based on a type specimen including an essentially complete skull and two referred specimens including skull fragments. It resembles *A. moreni* in having the posteroexternal

angle of the maxillary enlarged, its broad ventral plate underlapping the supraorbital process of the frontal; it differs in its smaller size, wider rostrum, shorter ascending process of maxillary, more robust zygomatic process of squamosal.—VMJ

05587 **Kellogg, Remington.** Fossil marine mammals from the Miocene Calvert Formation of Maryland and Virginia—Pt. 8, Supplement to description of *Parietobalaena palmeri*: U.S. Natl. Mus. Bull. 247, pts. 5–8, p. 175–197, illus., 1968.

This smallest species of the Calvert cetotheriid mysticetes was described by Kellogg in 1924 as type species of a new genus, with an immature cranium as type specimen; 20 referred specimens (15 collected since that date), include five skulls, representing a series of growth stages. This species is not far advanced in skull modification by either forward (as in modern balaenids) or backward (as in balaenopterids) overriding of adjacent bones. On immature skulls the posterior ends of the median rostral elements extend backward to the level of the preorbital angles of the supraorbital processes; at maturity they extend nearly to the level of the center of the orbit. The mandibular condyle is considered not reliable alone for defining related mysticete genera, because it widens and changes profile as the animal grows.—VMJ

05615 **Kellogg, Remington.** Fossil marine mammals from the Miocene Calvert Formation of Maryland and Virginia—Pt. 5, Miocene Calvert mysticetes described by Cope: U.S. Natl. Mus. Bull. 247, pts. 5–8, p. 103–132, illus., 1968.

Type material for eight species of mysticete cetaceans described by Cope (1868–96) is re-evaluated in light of later studies and in comparison with Van Beneden's (1859–86) Belgian Miocene types. Cope's mysticete types were based largely on postcranial elements, and much of the material is unidentifiable. *Eschrichtius cephalus* shows close affinity, or identity, with *Balaenoptera*. *E. pusillus* and *Megaptera expansa*, based on unidentifiable material, should be discarded. *Mesocetus siphunculus* probably should be assigned to *Isocetus*. *Metopocetus durinasus* shows affinity with *Mesocetus*. *Siphonocetus priscus* (Leidy) is not distinguishable from *Cetotherium*. *Ulias moratus* and *Tritulias buccatus* should be discarded. Cope's generic diagnoses for the last three species are invalid.—VMJ

Kennedy, George C. *See* Godovikov, Alexander A. 05295

Kennedy, George C. *See* Ito, Keisuke. 05344

Kennedy, John F. *See* Etter, Robert J. 05260

05287 **Kenney, T. C.** Shear strength of soft clay [with French résumé], *in* Geotechnical conference on shear strength properties of natural soils and rocks, Oslo, 1967, Proc., V. 2: Oslo, Norwegian Geotechnical Inst., p. 49–57, illus., 1968; Sess. 1, panel discussion, ibid., p. 107–110, illus., 1968.

The recent literature is reviewed critically to show that very little work has been done to determine the fundamental strength parameters of natural soft clays at or near their in-situ water contents. Considerable misunderstanding and controversy exist concerning interpretation of standard laboratory and field tests used to determine strength. Specimens experience excessive strains during sampling and laboratory handling, and consolidation changes their character. In design, a serious situation concerning the 'undrained' method of testing has arisen from findings that natural clays can exhibit anisotropic strength. Little effort has been given to study of effects of natural processes on the strength of natural clays. Closer cooperation is needed between personnel of universities, consultants, and contractors.—GDC

Kenney, T. C. *See* Bjerrum, L. 05368

05550 **Kenny, John E.** Scientific diver—Pt. 1, The geo-diver: Ocean Industry, v. 3, no. 12, p. 44–45, illus., 1968.

The question of whether man can be an effective scientific observer in the underwater environment, or whether he is better replaced by a waterproof, self-propelled computer with visual, tactile, and mechanical work capabilities will be decided by

economics. The geo-diver is working against time measured in minutes, and his effectiveness depends on how much data he can obtain within the limitations; some of the latest good tools are described. Although the procedure is difficult and expensive, those involved in it believe that direct underwater observation by geologists is a major contribution to sea-floor studies.—ESL

05719 **Kent, Harry C.** Biostratigraphy of Niobrara-equivalent parts of Mancos Shale (Cretaceous) in northwestern Colorado: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 11, pt. 1, p. 2098–2115, illus., tables, 1968.

Microfossils, particularly Foraminifera, from the part of the Cretaceous Mancos Shale in northwestern Colorado that is equivalent to the Niobrara Formation of the High Plains region can be used to establish biostratigraphic subdivisions and interpret paleogeographic conditions. The lower part of the Niobrara-equivalent strata in northern Colorado is termed informally the *Globorotalites* interval. The upper part of the Niobrara-equivalent strata is called the *Gavelinella* interval. The absence of keeled foraminifers in Niobrara-equivalent rocks in northwestern Colorado indicates colder water (probably less than 20°C) than in areas on the south and east. The colder water temperatures and the distribution of the fine-grained sediment probably resulted from a southward-directed, nearshore circulation system and an upwelling of deeper, colder water in the western interior seaway.—*from* Author's abstract

05308 **Kermeen, J. S.** Ore reserve estimation and grade control at the Phoenix mine, *in* Ore reserve estimation and grade control—Canadian Centennial Conf., Quebec, 1967: Canadian Inst. Mining and Metallurgy Spec. Vol. 9, p. 273–280, illus., tables, 1968.

The Phoenix mine, near the international boundary in south-central British Columbia, and a world-renowned produce of copper ore from 1900–1919, was re-opened in 1959 as an open-pit operation, recovering ore remaining in the underground workings. A geologic sketch map and table show the formations in the area; the geology of the Ironsides deposit is reviewed. The fact that it had been extensively stoped in the original operation hampers both mining and reserve calculations. An empirical method based on information on old plans and sections, standardized against recent pit experience, is applied to reserve estimations.—ESL

05373 **Kerr, Paul F.** The Marysvale, Utah, uranium deposits, *in* Ore deposits of the United States, 1933–1967 (Graton-Sales Volume), V. 2: New York, Am. Inst. Mining, Metall. and Petroleum Engineers, p. 1020–1042, illus., tables, 1968.

Uranium-bearing veins occur in intrusive quartz monzonite or granite and in nearby rhyolite. Replacement deposits are found in rhyolite intrusives and also in the lower portions of rhyolite flows close to places where vein-forming solutions contacted the rhyolite. Isotopic dates indicate that the uraninite-bearing veins are late Miocene or Pliocene, that the rhyolite is Miocene, and that the quartz monzonite and granite intrusives are late Oligocene. Two generations of alteration occur: (1) earlier alunitic veins and replacement bodies are found in the Oligocene Bullion Canyon Volcanic Series, none of which have produced uranium, and (2) later argillic alteration associated with the introduction of uranium is found along veins replacing glassy rhyolite dikes and replacing phases of the rhyolite.—*from* Author's abstract

Kerr, Paul F. *See* Hausen, Donald M. 05484

05338 **Kesler, Stephen E.; Heath, Stanley A.** The effect of dissolved volatiles on magmatic heat sources at intrusive contacts: Am. Jour. Sci., v. 266, no. 9, p. 824–839, illus., table, 1968.

Magmatic heat that is available for transfer to wall rock is derived from the heat in the silica fraction, the heat in the volatile fraction, and the heat of the reaction: magma $\rightarrow$ crystalline silicate + H_2O. The dissolved volatiles reduce the heat of the crystallization reaction. Calculations based on the ternary minimum granite liquidus and estimates of ΔV suggest that the heat of crystallization of granite magmas is substantially reduced at water pressures less than about 2,000 bars. A study of the heat available for heating wall rock during contact metamorphism and

ore deposition indicates that for granite magmas at water pressures near 1,000 bars the heat available from the volatile phase is approximately half the heat of crystallization and one-fourth the heat available from the silicate.—*from* Authors' abstract

05651 **Kesler, Stephen E.** Mechanisms of magmatic assimilation at a marble contact, northern Haiti: Lithos, v. 1, no. 3, p. 219–229, illus., tables, 1968.

Unusually large assimilation zones surround marble blocks in the 66 m.y.-old, epizonal Terre-Neuve quartz monzonite of northern Haiti. The Meme-Casseus zone, containing syenodiorite, granodiorite, and minor nepheline syenite, occupies more volume than did the marble block. Therefore, dispersal as well as addition of material was required to form the contaminated zones. Mechanisms of addition can include congruent or incongruent melting of wall rock at normal or depressed melting points followed by solution of the melted or solid rock by the magma; dispersal can take place by diffusion, crystal sinking, or convection. At the Meme-Casseus zone solution of solid marble was the dominant addition mechanism; dispersal was caused largely by convection. The relation of addition to dispersal suggests that formation of large assimilation zones is controlled by the mechanism of dispersal.—*from* Author's abstract

05675 **Kier, Porter M.** The Triassic echinoids of North America: Jour. Paleontology, v. 42, no. 4, p. 1000–1006, illus., 1968.

Triassic echinoids are rare, particularly in North America where only two species have been described [from California], both of which are based on [cidaroid] fragments which cannot be generically identified. These fragments are herein reillustrated and redescribed. More than two hundred specimens of a new genus and species, *Lenticidaris utahensis*, have been found in the Early Triassic Virgin Formation of Utah. This species belongs to the family Miocidaridae and is unique in having a highly flexible adapical surface.—Author's abstract

05711 **Kier, Porter M.** *Nortonechinus* and the ancestry of the cidarid echinoids: Jour. Paleontology, v. 42, no. 5, p. 1163–1170, illus., 1968.

The Devonian *Nortonechinus* [Lime Creek Shale, Iowa], a cidarid echinoid, and *Lepidocentrus*, an echinocystitid, have similar ambulacra with the radial vessel roofed over by perradial extensions of the ambulacral plates. The similarity of these two genera suggests that the cidarid stock probably descended from the echinocystitid stock. The following evolutionary trends apparently occurred within the cidarids: loss of the internal covering of the radial water vessel; reduction in the number of interambulacral columns; increase in the size of the interambulacral plates; decrease in imbrication of the plates; increase in size and complexity of the tubercles; increase in the size of the spines. It is suggested that most of these changes were related to the greater utilization of the primary spines.—Author's abstract

05760 **Kiilsgaard, Thor H.** Mineral exploration programs of the U.S. Government, *in* CENTO symposium on development and utilization of mineral resources, Karachi, Pakistan, 1968: Ankara, Turkey, Central Treaty Organization, p. 127–134, table, 1968.

Three general types of exploration programs are supported by the U.S. Government: research by the Geological Survey, Bureau of Mines, and other agencies. These are long-range, continuing programs that commonly contribute only indirectly to mineral exploration, but which have laid the ground work for discovery of a large amount of ore. The vast uranium exploration program of the late 1940's and early 1950's was of a scope far larger than commonly undertaken then by private mining companies; although expensive, it stimulated discovery of deposits worth many times its cost, and encouraged industry to enter the field. Exploration partly financed by the government but done by the mine operator has proved successful also. MCM

00009 **King, Lewis H.** Submarine end moraines and associated deposits on the Scotian Shelf: Geol. Soc. America Bull., v. 80, no. 1, p. 83–96, illus., 1969.

A submarine end-moraine complex occurs on the Scotian Shelf south and east of Halifax at 30–40 km offshore. It extends as a belt of low ridges which lies parallel to the presennt coast. Some of the larger individual ridges extend up to 55 km in length, with a slight arcuate pattern, and are an average of 50 m in height above the underlying bedrock. The full extent of the system has not been determined; however, a cursory examination indicates its occurrence along at least 500 km of the coast, in water depths ranging from 70–200 m. The materials forming the exposed portions of the ridges range from relatively unaltered to completely reworked glacial debris, depending on the depth of water in which they occur. Sub-bottom records and textural data on bottom samples indicate the occurrence of stratified proglacial deposits associated with the moraines.—*from* Author's abstract

King, N. J. *See* Fitzpatrick, G. L. 05182

05190 **Kinkel, Arthur R., Jr.; Lesure, Frank G.** Residual enrichment and supergene migration of gold, southeastern United States, *in* Geological Survey research 1968, Chap. D: U.S. Geol. Survey Prof. Paper 600-D, p. D174–D178, illus., tables, y968.

Recent study of some gold deposits in the southeastern United States indicates that both near-surface residual enrichment and supergene migration of gold occur in addition to normal placer formation. Residual surface enrichment results where soil particles are removed by surface wasting on gentle slopes. Thick colluvial material or recently farmed land may not show such surface enrichment. Appreciable amounts of gold in limonite deposited by ground water in many mine areas indicate the solution and migration of gold in ground waters, especially in the presence of oxidizing sulfides. Both residual surface enrichment and the supergene transport of gold should be considered in planning a program of geochemical sampling.—Authors' abstract

Kittel, Dale F. *See* Kelley, Vincent C. 05390

05262 **Klages, M. G.; Southard, A. R.** Weathering of montmorillonite during formation of a solodic soil and associated soils: Soil Sci., v. 106, no. 5, p. 363–368, illus., tables, 1968.

Results are reported of a study of clay mineral changes which accompany soil formation in a soil in northeastern Montana identified as solodic. The most important change was the lack of montmorillonite in the B horizon of one soil. The montmorillonite was replaced by a mineral so disordered in the C-axis direction that no basal reflections were observed on the X-ray diffraction traces. The nature of the clay mineral has not been determined, but research is continuing.—JWH

Klapper, Gilbert. *See* Orr, R. William. 05772

05253 **Kleinpell, Robert M.** Memorial to Ruben Arthur Stirton (1901–1966): Geol. Soc. America Proc. 1966, p. 393–400, portrait, 1968.

Knott, James M. *See* Scott, Kevin M. 05551

05341 **Kono, M.; Nagata, T.** Intensity of the Earth's magnetic field in geological time—[Pt.] 1, Late Pliocene in the southwestern U.S.A.: Jour. Geomagnetism and Geoelectricity, v. 20, no. 3, p. 211–220, illus., tables, 1968.

Basaltic rocks from 23 late Pliocene lava flows in New Mexico and Arizona were studied by Thellier's method and 17 intensity estimates were obtained. For both normal and reversed samples the field of intensity at the sampling locality at the time of lava flow was not greatly different from that of the present; estimates for the late Pliocene range from 0.35 oe to 0.82 oe, the mean value being 0.53 ± 0.14 oe. Comparison of magnitude of natural remanent with that of total thermoremanent magnetization produced in the laboratory could not give reliable intensity values in many cases, because most samples show changes in magnetic properties during heating. According to results from Rio Grande lavas the intensity fluctuations of the Pliocene geomagnetic field seem to have a much shorter period than the duration of a geomagnetic polarity epoch.—*from* Authors' abstract

05215 **Koster van Groos, A. F.; Wyllie, P. J.** Liquid immiscibility in the join $NaAlSi_3O_8$–Na_2CO_3–H_2O and its bearing on the genesis of carbonatites: Am. Jour. Sci., v. 266, no. 10, p. 932–967, illus., tables, 1968.

Phase relations in the above join were studied through the system Na_2O–Al_2O_3–SiO_2–CO_2–H_2O at 1 kb. Phases encountered were albite, cancrinite, sodium carbonate, a silica-rich liquid, an Na_2CO_3-rich liquid, and vapor. Albite is the main silicate phase at low water contents while cancrinite is the main silicate phase at high water contents. Three fluid phases coexist: (1) an undersaturated alkaline silicate liquid, (2) an alkaline carbonate liquid with a small amount of dissolved silicate, and (3) a vapor phase with a composition varying between H_2O and CO_2 and containing Na_2O and SiO_2 in solution. These fluid phases are compared with nepheline or ijolite magmas, carbonatite melts, and fenitizing solutions, respectively.—*from* Authors' abstract

05753 **Koteff, Carl; Oldale, R. N.; Hartshorn, J. H.** Geologic map of the Monomoy Point quadrangle, Barnstable County, Cape Cod, Massachusetts: U.S. Geol. Surrvey Geol. Quad. Map GQ-787, scale 1:24,000, text, 1968.

Monomoy Island, a sand spit, contains small amounts of gravel, and swamp and marsh deposits. The island is chiefly a product of wave erosion of large masses of glacial sand and gravel that form Cape Cod to the north; transportation by shore currents formed the spit, at times connected to the mainland of Cape Cod, or separated by storm waves. Shoreline changes are shown by comparison of topographic maps made by the U.S. Geological Survey in 1887, 1940, 1953, and 1964. The most important shape change has been the systematic regrading of the eastern shoreline to the north and the prograding southeastward of Monomoy Point. Subsurface geology is unknown, but may be inferred from the southern part of Cape Cod where glacial drift overlies crystalline rocks. The only resource is sand of low economic value.—MCM

05749 **Kozary, Myron T.** Ultramafic rocks in thrust zones of northwestern Oriente Province, Cuba: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 12, p. 2298–2317, illus., 1968.

Regional and detailed study of extremely complex relations between ultramafics in a small area in northwestern Oriente Province, Cuba, and small 'engulfed' slivers of nonultramafic rock-elements of a Cretaceous geosynclinal prism suggest that serpentinization of subcrustal peridotite of the 'oceanic' part of an east-trending Early Cretaceous geosynclinal depression raised the overlying gabbro crust; middle Cretaceous volcanism 'digested' the crust and crustal failure formed a trench north of the volcanic zone; Late Cretaceous collapse of the southern wall of the trench led to northward-directed crustal thrusts of gabbro and serpentinized ultramafics, which became gravity thrusts; thrust plates slid basinward, and some became recumbent folds; and in middle Eocene time serpentines in cores of folded thrust plates pierced confining structures, slivering the strata but stringing them out in structurally coherent order as 'flow thrusts'.—BHK

05325 **Krause, C. A.** Ore reserve estimation and grade control at Campbell Chibougamau, *in* Ore reserve estimation and grade control—Canadian Centennial Conf., Quebec, 1967: Canadian Inst. Mining and Metallurgy Spec. Vol. 9, p. 147–159, illus., tables, 1968.

In three mines and an open pit, operated near Chibougamau, Quebec, production up to June 30, 1966, had totalled 8,355,435 tons of 2.14 percent copper and .054 oz/ton gold. Proven and probable reserves as of that date totalled 9,051,354 tons of 2.36 percent copper and .056 oz/ton gold. The geologic setting is described and shown on a sketch map, and the geology of individual mines is discussed. The orebodies are relatively small and distribution of values is erratic, requiring careful planning and detailed drilling. The accuracy of the estimated ore reserves depends on correlations made by the geologist.—ESL

05225 **Krige, D. G.; Munro, A. H.** A review of some conceptual and practical implications of the use of valuation surfaces for gold ore reserve estimation, *in* Ore

reserve estimation and grade control—Canadian Centennial Conf., Quebec, 1967: Canadian Inst. Mining and Metallurgy Spec. Vol. 9, p. 33–40, illus., 1968.

The problem of describing the spatial variation in the gold content of ore is discussed in this paper, and the concept of a smooth surface is examined from the point of view of the valuation of ore reserves. Various approaches are mentioned, and the basis for the use of a weighted moving average technique for prediction is given. The progress which has been made in the application of this approach is reported and the trend of current research is indicated.—Authors' abstract

Kulp, J. Laurence. *See* Clark, George S. 05213

Kuo, J. *See* Nowroozi, A. A. 00002

05617 **Kupfer, Donald H.** A proposed deformation diagram for the analysis of fractures and folds in orogenic belts, *in* Internat. Geol. Cong., 23d, Prague, 1968, Proc., Sec. 13, Other subjects: Prague, Academia, p. 219–232, illus., 1968.

The proposed composite deformation diagram has the directions of maximum and minimum horizontal stress and the vertical as mutually perpendicular axes. Fold axes, thrusts, and reverse faults and some normal faults tend to parallel the minimum horizontal stress; conjugate right- and left-lateral strike-slip faults are vertical and near the 45° (oblique) position; foreland grabens, normal faults, and tension joints parallelthe maximum horizontal stress, which is the direction of principal horizontal stress. The diagram is empirical and appears to fit such diverse areas as Southern California (strike-slip), the Alps (thrusting), and the Appalachians (folding). If this deformation diagram proves to be commonly applicable for near-surface structures, it can aid in locating missing structural elements, analyzing changes in stress orientation, and recognizing structural misinterpretations.—*from* Author's abstract

05366 **Kwak, Teunis A. P.** Ti in biotite and muscovite as an indication of metamorphic grade in almandine amphibolite facies rocks from Sudbury, Ontario: Geochim. et Cosmochim. Acta, v. 32, no. 11, p. 1222–1229, illus., tables, 1968.

Biotite and muscovite from rutile-bearing schists (almandine amphibolite facies) near Sudbury, Ontario, both show a linear increase of Ti content with increasing grade (475 to 725°C). In biotite, the increase of molar proportion of Ti from about 0.2 to 0.5 is accompanied by a linear decrease in content of the other main octahedrally-bound cations. The partition coefficient between biotite and muscovite decreases 37 percent.—Author's abstract

Lachance, G. R. *See* Wanless, R. K. 05265

05288 **Ladanyi, B.** Shear strength of soft clay—Sess. 1, Open discussion, *in* Geotechnical conference on shear strength properties of natural soils and rocks, Oslo, 1967, Proc., V. 2: Oslo, Norwegian Geotechnical Inst., p. 133, 1968.

As a tool for undrained shear strength determination of saturated clays, the "static" deep cone test, which has been criticized even more often than vane test, has two important advantages: it gives continuous information on the undrained shear strength of clay, and its strength measurement is simultaneous with penetration, so there is no effect of previous disturbance as is sometimes the case when the vane test is performed in stiff and brittle clays. If the results of cone penetration tests in saturated clays are properly interpreted they can furnish information on the undrained strength of such clays, which is comparable to and more complete than that obtained from the best field vane tests and laboratory unconfined compression tests.—GDC

05369 **Ladanyi, B.** Shear strength of rock—Sess. 4, Free discussion, *in* Geotechnical conference on shear strength properties of natural soils and rocks, Oslo, 1967, Proc., V. 2: Oslo, Norwegian Geotechnical Inst., p. 252–253, illus., 1968.

Additional information on the behavior of rock after failure as obtained by the jacket cell-test described earlier is presented from tests on limestone specimens under identical conditions using only one type of jacket. In each test loading was stopped

at a different stress level to obtain a series with different amounts of deformation, for submission to uniaxial compression tests and determination of strength. Results show that mechanically unstable material such as rock can fail in compression in different ways: left free to deform laterally, instability on a macroscale results in almost total loss of strength; with lateral constraint, as in cell tests, the rock will fail by instability on a microscale, with only partial loss of strength. Between intact and completely broken rock there is an infinity of intermediate states of partial damage.—GDC

05370 **Ladanyi, B.** End restraint in undrained compression tests carried out to very large strains—Sess. 2, Free discussion on Shear strength of stiff clay, *in* Geotechnical conference on shear strength properties of natural soils and rocks, Oslo, 1967, Proc., V. 2: Oslo, Norwegian Geotechnical Inst., p. 160, 1968.

In tests for shear strength, by using a method for minimizing end restraint, proposed by Rowe and Barden (1964), clay specimens can be uniformly compressed to axial strains up to 30 percent. While the method of using a membrane and silicone grease between the sample and the platens may eliminate end restraint up to strains of 20 percent, equal success for axial strains of 50 percent or more seems doubtful. In a series of unconfined compression tests at the National Research Council of Canada it was found that at larger strains, even with measures taken for its minimization, the end restraint was still considerable and varied with strain; pressure at the center very quickly attained a value higher than the average and remained so throughout the test. However, if the stress distribution at the contact with the platens is continuously measured, reasonably accurate values of yield strength can be obtained.—GDC

05285 **Ladd, C. C.** Shear strength of soft clay—Sess. 1, Panel discussion, *in* Geotechnical conference on shear strength properties of natural soils and rocks, Oslo, 1967, Proc., V. 2: Oslo, Norwegian Geotechnical Inst., p. 112–115, illus., 1968.

Of concern here is the problem of determining in-situ undrained shear strength involving soft homogeneous saturated clays using a total stress stability analysis. The three most common methods used, at least in the U.S.A., are the field vane, the unconfined compression test, and triaxial compression tests on samples consolidated to the overburden pressure. Results of their use, compared from eight different sites, show considerable variation. Tests on Boston Blue clay of Massachusetts are considered in detail. The field vane which gives severe rotation of stresses may overestimate strength; unconfined compression tests may give good estimates if the sample is only slightly disturbed. Possible compensating errors are thus sample disturbance and an in-situ stress system different from triaxial compression.—GDC

LaMarche, Valmore C., Jr. *See* Helley, Edward J. 05175

05689 **Lane, H. Richard.** Symmetry in conodont element-pairs: Jour. Paleontology, v. 42, no. 5, p. 1258–1263, illus., 1968.

Of the four symmetry classes of conodont element-pairs recognized herein, two involve asymmetry. Asymmetry in the conodont-bearing organism need not preclude the concept of a nektonic mode of life, but it is clear that each conodont element was not part of a mirror-imaged pair. Interestingly, three of the four possible symmetry classes of conodont element-pairs are currently known to exist among scolecodont element-pairs of the polychaete jaw apparatus. Although not of suprageneric importance, the symmetry classification of conodont element-pairs is helpful in conodont taxonomy and can be useful in deciphering conodont lineages.—Author's abstract

Langenheim, R. J., Jr. *See* Frost, S. H. 05699

05528 **Langhus, B. G.** Palaeoecological and biostratigraphic zonation of Upper Cretaceous Foraminifera, Vancouver Island, British Columbia [abs.]: Bull. Canadian Petroleum Geology, v. 16, no. 3, p. 417–418, 1968.

05696 **Langston, Wann, Jr.** A further note on *Pachyrhinosaurus* (Reptilia Ceratopsia): Jour. Paleontology, v. 42, no. 5, p. 1303–1304, illus., 1968.

Reexamination of a skull referred to the Late Cretaceous thick-headed ceratopsian dinosaur *Pachyrhinosaurus* sp. cf. *P. canadensis* Sternberg, from the Edmonton Formation near Drumheller, [Alberta] Canada, shows the squamosal area of the frill to have been formed in the usual short-faced ceratopsid fashion. This revision of an earlier contrary interpretation removes the major obstacle to assigning the Drumheller specimen to *P. canadensis*, and reinforces earlier suggestions that *Pachyrhinosaurus* is best classed with the short-faced members of Ceratopsidae.—Author's abstract

Lanphere, Marvin A. *See* Reed, Bruce L. 00010

05418 **Lapham, Davis M.** Triassic magnetite and diabase at Cornwall, Pennsylvania, *in* Ore deposits of the United States, 1933–1967 (Graton-Sales Volume), V. 1: New York, Am. Inst. Mining, Metall. and Petroleum Engineers, p. 72–94, illus., tables, 1968.

Metallization, principally iron, but also silver, gold, cobalt, and sulfur, occurs as a limestone replacement above the essentially conformable, south-dipping portion of a discordant, saucer-shaped diabase sheet. Thermal metamorphism of carbonate-bearing country rocks largely to calc-silicates, is ubiquitous. Metasomatism, particularly of potassium, is unique to the ore zones. Magnetite-actinolite mineralization replaces, in a preferential sequence, all earlier metamorphic and metasomatic minerals and rarely the diabase chilled margin. Mineralogical and chemical zoning of the eastern orebody is focused downdip, near its western edge, along a major fault. Ore localization occurs by faulting, replaceable limestone, host textures, ore-fluid compositions, and fractionation of the magma. The ore was partitioned and fractionated from a basic magma by eH controls before the diabase intrusion.—*from* Author's abstract

05583 **Larese, Richard E.** Experimental diagenesis of quartz sands [abs.]: West Virginia Acad. Sci. Proc. 1968, v. 40, p. 261–262, 1968.

05290 **Larimer, John W.** Experimental studies on the system Fe-MgO-SiO_2-O_2 and their bearing on the petrology of chondritic meteorites: Geochim. et Cosmochim. Acta, v. 32, no. 11, p. 1187–1207, illus., tables, 1968.

Experimental data provide a thermodynamic basis for predicting Fe distribution between metal, olivine, and pyroxene as a function of pO_2 and T; an expression is derived relating pO_2, T, and olivine composition. The distribution coefficient K_D of Fe and Mg between olivine and pyroxene is found to be independent of temperature but dependent on composition in the range 1,100°–1,200°C. Comparison of experimental results with microprobe analysis of chondritic material indicates that meteorites have consistently larger K_D values than determined by experiment; this shows that most or all chondrites have equilibrated at temperatures below 1,100°C or have not equilibrated at all. Carbon and hydrogen reduction processes examined suggest that the bulk oxidation state was established at the time of accumulation.—DBV

05642 **LaRocque, Aurèle.** Pleistocene Mollusca of Ohio, Pt. 3 (of 4 pts.): Ohio Div. Geol. Survey Bull. 62, pt. 3, p. 357–553, illus., 1968.

Fresh-water gastropods of 120 species and varieties are described and figured, with type locality, ecology, general distribution of the living animals, distribution in Ohio, and geologic range noted. Index maps for each species or variety show distribution (living and fossil) in North America and Ohio. Gastropods of the subclass Streptoneura, order Ctenobranchiata (fresh-water gill breathers) are represented by the families Valvatidae, Viviparidae, Amnicolidae, Pomatiopsida, and Pleuroceridae; those of subclass Euthyneura, order Pulmonata (fresh-water lung breathers) by families Lymnaeidae, Planorbidae, Ancylidae, and Physidae. Not all species treated have been reported from the Ohio Pleistocene, but their discovery in it is a possibility.—VMJ

05194 **Larrabee, David M.** Serpentinite and rodingite in Hunting Hill quarry, Montgomery County, Maryland—A summary, *in* Geological Survey research 1968, Chap. D: U.S. Geol. Survey Prof. Paper 600-D, p. D195-D196, 1968.

A serpentinized dunite pluton four miles west of Rockville, Md., contains dikes of metasomatized gabbro—now rodingite. Forty-four minerals have been identified from the large active open quarry in which the rocks are well exposed. Rodingite intrusive bodies are as much as 1,500 feet long and 100 feet wide, and are composed of a mixture of bright-green diopside, cinnamon to pink grossularite, white diopside, zoisite, prehnite, and other minerals. These rocks are an important source of crushed stone in the Washington, D.C., area.—Author's abstract

Lattimore, Robert. *See* Peter, George. 00048

05520 **Lavery, Norman Garnsey.** Zinc dispersion in the upper Mississippi Valley zinc-lead district [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 29, no. 5, p. 1730B-1731B, 1968.

Lawton, M. D. *See* Skopos, M. J. 05318

05383 **Lea, Edgar R.; Dill, David B., Jr.** Zinc deposits of the Balmat-Edwards district, New York, *in* Ore deposits of the United States, 1933-1967 (Graton-Sales Volume), V. 1: New York, Am. Inst. Mining, Metall. and Petroleum Engineers, p. 20-48, illus., tables, 1968.

These complex ore deposits are contained within Precambrian marble of the Grenville Series. The Balmat orebodies are localized at various intervals throughout 1,800 feet of the section on the northwest side of a band of gneiss; the Edwards orebodies are located to the southeast of the gneiss. The orebodies are found within certain stratigraphic horizons where repeated alternation of competent and incompetent beds encouraged unusually complex folding. The orebodies, which are tabular, lenticular, or pod-like, have features suggesting parallelism to true bedding or modified flow banding; they occur where primary and secondary folds cross. The ore fluids were guided by secondary shearing and microbrecciation into structurally prepared areas in premetamorphic time.—*from* Authors' abstract

05506 **Leavitt, E. M.** Petrology, palaeontology, Carson Creek North reef complex, Alberta: Bull. Canadian Petroleum Geology, v. 16, no. 3, p. 298-413, illus., tables, 1968.

This subsurface reef in west-central Alberta, and its platform, form the Swan Hills Formation of the Beaverhill Lake Group, Middle to Late Devonian in age. Structure and isopach maps, and cross sections illustrate the atoll-like geometry and paleotopography. Stromatoporoids and algae were most important reef organisms; brachiopods, corals and other fossils are common. The complex may be subdivided into 7 biotopes, each having distinctive biosomes; and into 5 facies, 11 microfacies, and 32 rock types. A number of diagenetic factors affected the reef limestones, but original sedimentary features are not greatly altered. The geological history of the reef complex has been portrayed in 6 stages: reef platform, biostromal-type carbonate; biohermal reef growth; green shale, in soluble residue; calcarenite bank; reef death, regression and erosion; and argillaceous sedimentation.—*from* Author's abstract

05525 **Leavitt, E. M.; Fischbuch, N. R.** Devonian nomenclatural changes, Swan Hills area, Alberta, Canada: Bull. Canadian Petroleum Geology, v. 16, no. 3, p. 288-297, illus., table, 1968.

Subsurface data, produced over a decade of drilling, can now be used to reassess Devonian nomenclature in the Swan Hills area. It is proposed that the Swan Hills Member, the hydrocarbon producing unit of the Beaverhill Lake Formation be raised to formation status; the off-reef nodular shales or upper Beaverhill Lake is designated as the Waterways Formation (Murray, 1965); and the basal Beaverhill Lake is divided into the Fort Vermilion Formation and part of the Watt Mountain Formation. The redefined Swan Hills, Waterways, and Fort Vermilion are referred to as the Beaverhill Lake Group. Cross sections show their correlation from the

Swan Hills area to the type areas north, northeast, and southeast. In the Swan Hills area, the Fort Vermilion and basal Swan Hills Formation are considered Middle Devonian in age, and the upper Swan Hills and the Waterways Formation Late Devonian.—*from* Authors' abstract

05533 **Lee, D. T. C.** Structural analysis in Letang Peninsula and Frye Island, Charlotte County, New Brunswick [abs.]: Bull. Canadian Petroleum Geology, v. 16, no. 3, p. 420–421, 1968.

05195 **Lee, Donald E.; Stern, T. W.; Mays, R. E.; VanLoenen, R. E.** Accessory zircon from granitoid rocks of the Mount Wheeler mine area, Nevada, *in* Geological Survey research 1968, Chap. D: U.S. Geol. Survey Prof. Paper 600–D, p. D197–D203, illus., tables, 1968.

Twenty–five accessory zircon fractions recovered from granitoid rocks exposed just north of the Mount Wheeler mine area, Nevada, have been studied. Minor–element contents are listed for all; physical properties and radiometric age data are given for a few. Results support the conclusion reached from previous work on other minerals and indicate that the large compositional range and systematic chemical gradients found in the intrusive rocks result more from assimilation of sedimentary rocks than from differentiation of magma. Uranium–thorium–lead isotope ages given by one zircon concentrate date the time of crystallization as Middle Jurassic. Pb/α determinations on three zircon fractions recovered from small xenoliths gave mid–Tertiary ages, and these low ages appear to result from loss of lead.—Authors' abstract

05530 **Legault, Jocelyne.** The conodont fauna of the Stonehouse Formation, Arisaig, Nova Scotia [abs.]: Bull. Canadian Petroleum Geology, v. 16, no. 3, p. 418, 1968.

Leone, R. J. *See* Ensign, C. O., Jr. 05409

LeRoux, E. F. *See* Adolphson, D. G. 05177

Lesure, Frank G. *See* Kinkel, Arthur R., Jr. 05190

05267 **Levengood, C. A.** Elmer Lawrence Lucas, 1898–1966: Oklahoma Acad. Sci. Proc. 1966, v. 47, p. 487, 1968.

05304 **Lewis, C. F. M.** Late Quaternary events on Manitoulin Island, *in* The geology of Manitoulin Island—Michigan Basin Geol. Soc., Ann. Field Excursion, 1968: [Lansing, Mich., Michigan Geol. Survey] p. 60–67, illus., 1968.

The Quaternary history of Manitoulin Island is reviewed, with a description of the evidence which is present on the island. Scoured bedrock as well as local deposits of till left by the last major Wisconsin ice advance are found. Lake Algonquin and post–Algonquin lake shorelines can be observed on the island. The post Algonquin glacial rebound can be detected in lake advances and retreats, the island emerging with the last rebound. Various low–level lake phases and the Nipissing Great Lakes are apparent also. The post–Nipissing phases can be seen in the steady emergence of the island, the present level being obtained about 2,500 years B.P.—HRC

Libby, Fred J. *See* Spangler, Daniel P. 05746

05274 **Liberty, B. A.** Ordovician and Silurian stratigraphy of Manitoulin Island, Ontario, *in* The geology of Manitoulin Island—Michigan Basin Geol. Soc., Ann. Field Excursion, 1968: [Lansing, Mich., Michigan Geol. Survey] p. 25–37, illus., 1968.

Middle Ordovician to MiddleSilurian strata inclusive are well exposed in the Manitoulin Island area. They are typically carbonate with limestone dominance in the Silurian. These strata correlate readily with northern Michigan, central Ontario, and New York State. As these lithostratigraphic units are traceable both westward and southward, the lithologic nomenclature is considered applicable throughout southern Ontario.—Author's abstract

Liberty, Bruce A. *See* Michigan Basin Geological Society. 05266

05332 **Likens, Gene E.; Johnson, Philip L.** A limnological reconnaissance in interior Alaska: U.S. Army Materiel Command Cold Regions Research and Eng. Lab. Research Rept. 239, 41 p., illus., tables, 1968.

Chemical, physical and biological measurements were made in 40 lakes and 9 other aquatic habitats, primarily in the Tanana and Yukon River drainages; 22 to 24 lakes were monomictic, 13 to 15 dimictic, and 3 meromictic types. Lake waters in both drainages were generally very alkaline. In several lakes concentrations of sulfate and magnesium exceeded potable limits. The chemistry of surface water from various springs and the Arctic Coastal Plain was contrasted with that of the interior lakes. Sediment temperatures demonstrated a significant feature of unfrozen lakes in cold regions—a considerable net amount of heat flows from the water to underlying sediments annually. Light penetration varied widely. A relatively high rate of carbon fixation was measured in C-14 experiments.—*from* Authors' abstract

05728 **Link, James M.; Keenan, Albert M.** A review of the coal industry in the western United States: Colorado School Mines Mineral Industries Bull., v. 11, no. 5, 24 p., illus., tables, 1968.

Production of primary energy in the western United States indicates that energy requirements will double between 1960 and 1980; coal is being used primarily by utilities and the steel industry. More than half of the potential coal reserves lie in a belt about 500 miles wide that straddles the Rocky Mountains and runs from Canada to Mexico; they could satisfy the U.S. needs for at least 700 years. Quality of these coals varies both in carbon content and volatile matter. A sketch map shows the coal fields of the western states and a table lists the principal coal fields with data on formation, age, rank, and reserves. A considerable portion of the paper is devoted to economics, mining, and marketing.—MCM

05364 **Linn, Robert K.** New Idria mining district, *in* Ore deposits of the United States, 1933–1967 (Graton–Sales Volume), V. 2: New York, Am. Inst. Mining, Metall. and Petroleum Engineers, p. 1623–1649, illus., tables, 1968.

The New Idria district in San Bernardino and Fresno Counties is noted for mercury and asbestos. The Coalinga anticline, the major structure, is composed of Jurassic to Quaternary rocks. The serpentine core, rimmed by Franciscan sandstone was intruded along faults during the Cretaceous. The chief ore mineral is cinnabar deposited in fractures and stockworks in altered Panoche shale and in fissure veins in the Franciscan. Rocks made amenable to fracturing by hydrothermal alteration were fractured by late faulting, and the fracture zones are the principal controls for the ore shoots, the largest and richest being in the New Idria mine.—*from* Author's abstract

05862 **Litvin, V. M.** Geomorfologiya sredinno-okeanicheskogo khrebta v Norvezhskom i Grenlandskom moryakh [with English summ.]: Okeanologiya, v. 8, no. 1, p. 86–93, illus., 1968.

The continuation of the mid-oceanic ridge north of Iceland has been definitely established as a result of marine geologic investigations in 1955–65. The ridge is divided into three sectors: the Icelandic-Jan Mayen Ridge, Mona Ridge, and Knipovich Ridge. A rift valley in the form of narrow, deep en echelon depressions extends along the axis of these ridges, which structurally resemble the graben zone and rift mountains of the Mid-Atlantic Ridge with which they are connected via the central Icelandic graben. Tertiary plateau basalts are found on either side of the central Icelandic graben, in eastern Greenland, the Faeroe Islands, and Scotland; these originally formed a single basalt plateau which broke apart and submerged unevenly. Thus in Upper Tertiary time the mid-oceanic ridge made its way through this plateau as the central Icelandic graben and Icelandic-Jan Mayen Ridge.—DBV

05736 **Lliboutry, L.** Steady-state temperatures at the bottom of ice sheets and computation of the bottom ice flow law from the surface profile [with French and German abs.]: Jour. Glaciology, v. 7, no. 51, p. 363–376, illus., 1968.

A solution for steady flow of a cold ice sheet is recalled which takes account of heat released by deformation. As this heating increases strain velocity, bottom temperature may be unstable. A set of five equations with five unknowns is written which allows the surface profile and bottom temperature to be computed step by step by an iterative process. This was done by computer for three models of ice sheets, and in each case with three distinct values of constant B in Glen's ice flow law. In every case steady-state temperature profiles could not be computed beyond a moderate distance from the ice divide. The correct value of B for bottom ice may be deduced from the actual surface profile. At the bottom of Greenland ice sheet, B is about 2.18 $bar^{-3}yr^{-1}$, about 13 times bigger than for most alpine glaciers.—*from* Author's abstract

05710 **Lochman, Christina.** *Crepicephalus* faunule from the Bonneterre Dolomite (Upper Cambrian) of Missouri: Jour. Paleontology, v. 42, no. 5, p. 1153–1162, illus., 1968.

Five benthonic trilobite genera, *Lonchocephalus, Welleraspis, Komaspidella, Glaphyraspis*, and *Coosina*, and a planktonic form, *Pemphigaspis*, occur in burrowed, pelletized carbonate alternating with planar stromatolites. The faunule is the first record of the *Crepicephalus* Zone in Missouri. The same suite is found in similar facies in the Appalachian region; only one of the benthonic genera, *Lonchocephalus* is known from rocks of similar age but different facies in the Upper Mississippi Valley.—REG

Lodding, William. *See* Isphording, Wayne C. 05571

05666 **Loeblich, Alfred R., 3d; Loeblich, Laurel A.; Tappan, Helen; Loeblich, Alfred R., Jr.** Annotated index of fossil and Recent silicoflagellates and ebridians with descriptions and illustrations of validly proposed taxa: Geol. Soc. America Mem. 106, 319 p., illus., 1968.

All published silicoflagellate and ebridian [siliceous microplanktonic Protista] taxa of generic rank and lower, both fossil and Recent, are indexed. Original publication and geographic and geologic provenance are cited, and nomenclatural status indicated by type face. Invalid taxa are annotated as to reason for such status. Later published new combinations are indexed with reference to original name. Of the 1037 entries, 404 refer to the original valid publication of new taxa; original diagnoses for these are quoted in the original language and the original illustrations are reproduced under the original names. Introductory sections include a brief review of previous work on the organisms and problems pertaining to their systematic position, geologic and geographic distribution, and the availability of published information.—*from* Authors' abstract

Loeblich, Alfred R., Jr. *See* Loeblich, Alfred R., 3d. 05666

Loeblich, Laurel A. *See* Loeblich, Alfred R., 3d. 05666

05686 **Logan, Alan; McGugan, Alan.** Biostratigraphy and faunas of the Permian Ishbel Group, Canadian Rocky Mountains: Jour. Paleontology, v. 42, no. 5, p. 1123–1139, illus., 1968.

The Permian Ishbel Group in the Canadian Rockies represents Phosphoria depositional conditions and has a minimal age span of Wolfcampian to Guadalupian. Fossils described from ten stratigraphic sections [productid, chonetid, and spiriferid brachiopods, an omphalotrochid gastropod, and an edestid elasmobranch fish] suggest time correlation not only with the Phosphoria Formation of the U.S.A., but also with Permian successions in Oregon, British Columbia, Northwest Territories and Yukon, Canadian Arctic Islands, Greenland, Svalbard, Russia, and West Pakistan. Similarity in age of faunas above and below an extensive physical unconformity within the Permian implies differential time lapse with diachronism of the beds above the unconformity.—*from* Authors' abstract

Loleit, Allan J. *See* Peterson, James A. 05606

05521 **Lomenick, Thomas Fletcher.** Accelerated deformation of rock salt at elevated temperature and pressure and its implications for high level radioactive waste disposal [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 29, no. 5, p. 1731B, 1968.

Lomnitz, Cinna. *See* Bolt, B. A. 05458

05507 **Longacre, Susan Ann Burton.** Trilobites of the Upper Cambrian ptychaspid biomere, Wilberns Formation, central Texas [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 29, no. 5, p. 1731B, 1968.

05443 **Loranger, D. M.** An integrated exploration tool: Oilweek, v. 19, no. 43, p. 21–22, illus., 1968.

Paleoecology is an important tool in the discovery of reefs, particularly in Alberta, but its techniques are not readily available to many geologists. The relations of paleoecology to geology, biology, physics, diagenesis, and paleontology are examined and discussed in the light of how they can be integrated for more valid interpretations. As applied to exploration, the discipline can be used to verify existing interpretations or provide new information on: correlation; stratigraphy; identification of ancient environments; sedimentation; paleoecological factors (salinity, water depth, hydrocarbon preservation); unconformities, disconformities, and diastems; and basin tectonics. Paleoecology, by substantiating other work and by providing information not obtainable by conventional tools, provides for more reliable channeling of exploration effort.—MCM

00011 **Lovell, J. P. B.** Tyee Formation—Undeformed turbidites and their lateral equivalents, mineralogy and paleogeography: Geol. Soc. America Bull., v. 80, no. 1, p. 9–21, illus., tables, 1969.

The facies and mineralogy of the Tyee Formation of middle Eocene age in the Oregon Coast Range are used to define a paleogeography of part of western Oregon. The formation consists largely of undeformed and unmetamorphosed sandstones, which would be called graywackes or wackes by most classifiers. It provides a rare example of a lateral transition from turbidite to nonturbidite sediments; a northern marine turbidite facies can be traced southward into a coeval nearer shore facies. Southern source areas of both the sedimentary material and the turbidity currents can be recognized.—Author's abstract

00041 **Lowman, Paul D., Jr.** Composition of the lunar highlands—Possible implications for evolution of the Earth's crust: Jour. Geophys. Research, v. 74, no. 2, p. 495–504, 1969.

This paper is a theoretical investigation of implications for origin of the Earth's continents and ocean basins of three possible chemical compositions for the lunar highlands. Ultrabasic or basic lunar highlands would imply that the existence of sialic crust on the Earth is due to some major difference between Earth and Moon. A basic composition for the lunar highlands would imply that basic crustal layers of the Earth are remnants of a primordial basaltic crust. Sialic lunar highlands would imply that the Earth's continents are essentially igneous, and were derived from the mantle early in geologic time. The nearly global extent of the lunar highlands suggests that the Earth's crust has evolved by growth of ocean basins rather than growth of continents, perhaps by foundering of continental segments under flood basalts as proposed by Belousov.—*from* Author's abstract

Luedke, Robert G. *See* Burbank, Wilbur S. 05388

Lumsden, W. W. *See* Moores, E. M. 05263

05284 **Lundgren, R.** Use of the finite element method for rock stability studies—Sess. 4, Panel discussion on *Shear strength of rock, in* Geotechnical conference on shear strength properties of natural soils and rocks, Oslo, 1967, Proc., V. 2: Oslo, Norwegian Geotechnical Inst., p. 238–239, 1968.

The finite element method has been used successfully to analyze stability of rock cavities. For rock mechanics problems its advantages include the use of any

arbitrary boundary geometry, and possible consideration of layering, jointing, faulting as well as other discontinuities or nonhomogeneities; effects of rock bolting and other reinforcements; the initial stress field in the rock mass; anisotropy of material properties; and, with the considerable amount of freedom in the equations of state that can be used, many types of static stress–strain curves, time dependencies, and material–failure criteria; and other classes of problems, such as of dynamics or flow. Several examples of the types of problems to which the method has been applied are cited. The present limitation is in determining the material properties to be used in the analysis, for which new loading devices hold promise.—GDC

05727 **Lytle, William S.; Heyman, Louis; Wagner, Walter R.** Oil and gas developments in Pennsylvania in 1967: Pennsylvania Geol. Survey, 4th ser., Prog. Rept. 175, 38 p., illus., tables, 1968.

Exploratory drilling in 1967 resulted in the discovery of a new Oriskany gas pool in Cambria County, an Upper Devonian gas field in Clinton County, and an extension of an Upper Devonian gas pool in Indiana County. During continuing development of the deep–sand fields in Erie and Crawford Counties, 34 Medina gas wells were completed. The Elk Run gas field in Jefferson County is a stratigraphic trap typical of the NE–SW trending series of 'Oriskany' fields on the east limb of the Sabinsville anticline in west–central Pennsylvania; the gas is considered to be localized by the distribution of the over 6 percent porosity in the sandstone. Crude oil production increased 1.2 percent over 1966 production, but natural gas production decreased slightly.—MCM

MacClintock, Copeland. *See* Pannella, Giorgio. 05858

05307 **MacIsaac, W.; Ford, R. E.** Grade control at Gaspe Copper Mines Limited, *in* Ore reserve estimation and grade control—Canadian Centennial Conf., Quebec, 1967: Canadian Inst. Mining and Metallurgy Spec. Vol. 9, p. 265–272, illus., 1968.

The three extensive low–grade copper deposits at Murdochville, Quebec, are discussed: the underground orebodies, Needle Mtn. open pit, and Copper Mtn pit, all at the eastern end of the Shick–Shock Mts. Local stratigraphy and relations of the three orebodies are shown. The areas have been subjected to high temperature metamorphism and ore occurs in the altered zones. At Needle Mtn., orebodies are bedded replacement deposits with faults providing channelways; chalcopyrite and bornite are the chief ore minerals. Diamond drilling and geologic mapping provide information for detailed pit layouts, and visual estimation is the chief means of grade control. At Copper Mtn., mineralization occurs in closely spaced fractures and consists chiefly of chalcopyrite and pyrite. Extensive sampling is necessary because of the irregular distribution of copper.—ESL

Mackenzie, W. Bruce. *See* Wallace, Stewart R. 05400

05372 **Mackin, J. Hoover.** Iron ore deposits of the Iron Springs district, southwestern Utah, *in* Ore deposits of the United States, 1933–1967 (Graton–Sales Volume), V. 2: New York, Am. Inst. Mining, Metall. and Petroleum Engineers, p. 992–1019, illus., tables, 1968.

These orebodies are replacement deposits of magnetite and hematite in Jurassic limestone around the borders of three intrusions of quartz–monzonite porphyry. The intrusions are laccoliths, emplaced at the same stratigraphic horizon (a décollement zone of Laramide age), and are post–orogenic in age. There was no change of thickness of the limestone during the metallization. The ore–forming fluid was derived from the exposed porphyry. The iron was first incorporated in hydroxyl–bearing mafics which crystallized in depth and were carried upward in the magma that formed the hypabyssal intrusions. The mafic phenocrysts decayed deuterically releasing iron into the interstitial fluid of a consolidating crystal mush within the intrusions, and tension joints served as roots through which ore–forming fluid was drawn from the mush.—*from* Author's abstract

05279 **MacLaren, A. S.; Charbonneau, B. W.** Aeromagnetic map—Manitoulin Island, *in* The geology of Manitoulin Island—Michigan Basin Geol. Soc., Ann. Field Excursion, 1968: [Lansing, Mich., Michigan Geol. Survey] p. 77–78, illus., 1968.

Magnetic data over the island has little preferred orientation, and the anomalies originate from the Precambrian basement rocks underlying the Paleozoic cover. The range in magnetic intensity is 300 gammas. There are two exceptions to the random magnetic pattern: a narrow belt of anomalies extending southwest to Heywood Island north of Bold Point and a north-east lineation off the east end of the island. The former trend is attributed to volcanic rocks underlying the north channel while the latter may coincide with the Greenville "front". A small-scale map is included. Other detailed features are identified, such as the South Bay complex, an anomaly over a possible carbonatite body, the Murray fault, and an offset diabase dike.—HRC

05441 **MacLeod, William D., Jr.** Combined gas chromatography–mass spectrometry of complex hydrocarbon trace residues in sediments: Jour. Gas Chromatography, v. 6, no. 12, p. 591–594, illus., table, 1968.

Complex traces of sedimentary hydrocarbons up to $C_{31}H_{64}$ were examined by combined GC–MS for evidence of biological origin. The system described can analyze a complex extract of 10^{-4}–10^{-5} g in a single sampling. Where GC separation permitted, individual hydrocarbons amounting to less than 10^{-7} g were identified. The hydrocarbon distribution in the very old Onverwacht sedimentary rock was compared and contrasted with that found in a recent unconsolidated Santa Barbara Basin sediment.—Author's abstract

05524 **Macqueen, R. W.; Bamber, E. W.** Stratigraphy and facies relationships of the Upper Mississippian Mount Head Formation, Rocky Mountains and foothills, southwestern Alberta: Bull. Canadian Petroleum Geology, v. 16, no. 3, p. 225–287, illus., tables, 1968.

This widespread Meramecian formation of the Rundle Group consists of 500 to 1,000 feet of limestones and dolomites, with local shales, sandstones, siltstones and solution breccias, all of shallow marine origin. In the eastern ranges six members are clearly recognizable from Crowsnest Pass to Bow Valley, north of which they lose their distinctive character. Facies changes in the lower four members progress westward into skeletal limestones of the underlying Livingstone Formation. The dolomites and micritic limestones of the overlying lagoonal members pass westward into barrier shoal and open marine beds of the Opal Member, a new name; only the upper part of the Carnarvon Member extends west to overlie the Opal, with a return to lagoonal conditions. Correlations across facies changes are supported by the stratigraphic distribution of four assemblages of corals and brachiopods.—*from* Authors' abstract

05773 **MacTavish, John N.; Malone, Philip G.; Wells, Terry L.** RMAR—A reduced major axis regression program designed for paleontologic data: Jour. Paleontology, v. 42, no. 4, p. 1076–1078, table, 1968.

RMAR is a computer program designed for biometric analysis of paleontologic data. The program will do univariate and bivariate analysis for all possible pairs of three variates. The construction is understandable by anyone who has an elementary knowledge of FORTRAN IV and is easily adapted for a number of uses in both research and teaching.—RCD

05740 **Macurda, Donald B., Jr.** Ontogeny of the crinoid *Eucalyptocrinites*, *in* Paleobiological aspects of growth and development, a symposium: Paleont. Soc. Mem. 2 (Jour. Paleontology, v. 42, no. 5, supp.), p. 99–118, illus., 1968.

The calyx of a Paleozoic camerate crinoid is composed of a mosaic of large polygonal plates. Ontogenetic size increase results from accretionary additions of calcite to thecal plates. Ontogenetic development can be studied by measurement of a growth series. This is illustrated by regression analysis of growth series of two Silurian species of the genus *Eucalyptocrinites: E. crassus* and *E. tuberculatus* [from Waldron Shale of Indiana and Tennessee]. Growth of the principal plates is isometric, most growth parameters have a very similar mode of development in both species, and only a few parameters show any specific difference. Several synonymies are suggested.—*from* Author's abstract

05742 **Macurda, Donald B., Jr.** (editor). Paleobiological aspects of growth and development, a symposium: Paleont. Soc. Mem. 2 (Jour. Paleontology, v. 42, no. 5, supp.), 119 p., illus., tables, 1968.

In an attempt to bring together some of the ideas on growth and development, information that has not been fully exploited by paleontologists, the Paleontological Society presented a symposium during the 80th annual meeting of the Geological Society of America in New Orleans, La., Nov. 27, 1967. Nine papers were presented, of which seven and an abstract are published here, the ninth being published elsewhere. The papers are cited separately under: J. T. Bonner, W. A. Oliver, Jr., M. J. S. Rudwick, D. M. Raup, G. Pannella, S. J. Gould, D. B. Macurda, Jr., M. R. Voorhies.—VMJ

05415 **Magee, Maurice.** Geology and ore deposits of the Ducktown district, Tennessee, *in* Ore deposits of the United States, 1933–1967 (Graton–Sales Volume), V. 1: New York, Am. Inst. Mining, Metall. and Petroleum Engineers, p. 207–241, illus., tables, 1968.

Eight massive sulfide orebodies occur in highly folded and metamorphosed graywacke, graywacke conglomerate, mica schist, chlorite–garnet schist, and staurolite schist of Precambrian age. The orebodies are tabular and have been extensively folded; they generally conform to the enclosing rocks, but show local complex differences. The deposits are principally pyrrhotite, pyrite, chalcopyrite, sphalerite, and magnetite; gangue minerals are quartz, calcite, tremolite, and others. Three fault systems are present and have influenced ore control and ore-body configuration. Hydrothermal effects are evident in wall-rock alteration, as is retrograde metamorphism. Preliminary age dates have suggested four Paleozoic metamorphic events. Ore genesis is by hydrothermal replacement of receptive beds, predominantly calcareous zones, quartzitic zones, and brecciated shear zones.—*from* Author's abstract

05658 **Maher, William J.** Muskox bone of possible Wisconsin age from Banks Island, Northwest Territories: Arctic, v. 21, no. 4, p. 260–266, illus., 1968.

Part of a metacarpal of *Ovibos* was found in 1963 on Banks Island, Northwest Territories, near 121°54′ W., 73°23′ N. The bone was indistinguishable from *Ovibos moschatuus*. A C-14 date in excess of 34,000 years was determined. The possible existence of a Wisconsin refugium on Banks Island is discussed. Evidence suggests that a refugium existed there isolated from Beringia. In addition to plant species, two small mammal species (*Lemmus sibiricus* and *Lepus arcticus*) and possibly muskoxen survived in the Banks Island refugium.—Author's abstract

05392 **Malan, Roger C.** The uranium mining industry and geology of the Monument Valley and White Canyon districts, Arizona and Utah, *in* Ore deposits of the United States, 1933–1967 (Graton–Sales Volume), V. 1: New York, Am. Inst. Mining, Metall. and Petroleum Engineers, p. 790–804, illus., table, 1968.

All the important uranium deposits in the two districts are in the Shinarump, the basal member of the Chinle Formation. The Shinarump lies on a widespread unconformity and is composed of fluviatile sediments, generally less than 100 feet thick that were deposited by streams flowing from source to the south. Uranium-bearing Shinarump sediments were eroded before lithification and redeposited elsewhere as Shinarump, thus concentrating the uranium in carbonaceous portions as the original uranium was widely dispersed.—HRC

05449 **Malde, Harold E.** The catastrophic late Pleistocene Bonneville flood in the Snake River plain, Idaho: U.S. Geol. Survey Prof. Paper 596, 52 p., illus., 1968.

A catastrophic flood from Lake Bonneville 30,000 years ago almost certainly was caused by capture of Bear River, resulting in overflow at a level 100 feet above the Bonneville shoreline. This overflow released 380 cu mi of lake water at a maximum rate of 1/3 cu mi–hr. Passage of floodwater down the Snake River Canyon formed spectacular erosion features including scabland and deposited the Melon Gravel, a debris of poorly sorted basalt boulders and sand. This erosion accounts for most of the 6/10 of a cu mi of flood debris dumped in the canyon

downstream, which accumulated where floodwater 300 feet deep was impounded behind canyon necks. Flow velocities expressed by boulders as large as 10 feet in Melon Gravel along canyon constrictions indicate about the same discharge as computed by the critical-depth method at a canyon neck near Swan Falls. This extraordinary flood is briefly compared with several great historic floods.—HEM

Malone, Philip G. *See* MacTavish, John N. 05773

05508 **Mamet, B. L.; Mason, D.** Addendum—Foraminiferal zonation of the Lower Carboniferous Connor Lakes section, British Columbia: Bull. Canadian Petroleum Geology, v. 16, no. 3, p. 423, 1968.

In the section location map of the original paper (ibid., no. 2, p. 147–166), the Permian system has been overlooked. Extrapolation from a measured section north of Forsyth Creek (McGugan and Rapson, 1964) indicates that Permian strata occur at the top of the upper part of Section CK, in the interval 10,588 feet–10,883 feet. This interval is poorly exposed and is not discussed in the text.—GDC

05436 **Manheim, F. T.; Horn, M. K.** Composition of deeper subsurface waters along the Atlantic continental margin: Southeastern Geology, v. 9, no. 4, p. 215–236, illus., table, 1968.

In order to understand better the composition and distribution of deeper subsurface waters beneath the Coastal Plain and continental margin of the eastern United States, the authors have utilized available electrical logs from oil tests, existing water analysis, literature studies from specific areas and analysis of pore fluids from recent drill cores. Their chief conclusions are: (1) Sediments in the first 1,000 m are usually greatly influenced by meteoric waters. (2) Irregular fluctuations between brackish and shale waters characterize deeper waters, with a strong tendency for increase in salinity with depth. (3) Concentrated brines seem to be associated with redbeds and evaporitic sediments. (4) Salt filtration by clay membranes appears inapplicable to the Coastal Plain strata; rather, clay membranes promote osmotic flushing of salty strata by fresher waters.—*from* Authors' abstract

Mann, E. L. *See* Dean, A. W. 05339

05499 **Manus, Ronald Warren.** Experimental chemical weathering of two alkali feldspars [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 29, no. 5, p. 1776B, 1968.

05184 **Mapel, William J.; Sandberg, Charles A.** Devonian paleotectonics in east-central Idaho and southwestern Montana, *in* Geological Survey research 1968, Chap. D: U.S. Geol. Survey Prof. Paper 600-D, p. D115–D125, illus., table, 1968.

Post-Devonian low-angle thrust faults have greatly modified the original thicknesses of Devonian and some older Paleozoic rocks in a large area north of the Snake River Plain. Along the Idaho-Montana State line, extreme thinning of Devonian rocks, which previously had been cited as evidence for emergence of a Late Devonian Tendoy dome, is reinterpreted as partly due to faults. Slight thinning along the north side of the so-called Tendoy dome is interpreted to be the result of thinner deposition over the west end of an eastward-trending 300-mile-long ancestral Yellowstone Park uplift.—Authors' abstract

05412 **Marsden, R. W.; Emanuelson, J. W.; Owens, J. S.; Walker, N. E.; Werner, R. F.** The Mesabi Iron Range, Minnesota, *in* Ore deposits of the United States, 1933–1967 (Graton-Sales Volume), V. 1: New York, Am. Inst. Mining, Metall. and Petroleum Engineers, p. 518–537, illus., tables, 1968.

The ore occurs in the Biwabik Formation as trough ore bodies in elongated channels and as irregular and tabular deposits in fractured areas associated with faults and folds. The ore bodies, which are all sizes and may occur anywhere within the formation, are believed to have formed by oxidizing and leaching action of surface waters. Magnetite-taconite occurs as stratigraphic zones in the same formation. Unoxidized taconite has an extensive distribution away from and between channels of oxidation and leaching but only a part of the unoxidized taconite is of ore quality. Two types of magnetite-taconite occur: that of the main Mesabi Range, and that

of the eastern Mesabi Range. The magnetite occurs with different types of silicates and therefore requires different processing.—*from* Authors' abstract

05410 **Marsden, Ralph W.** Geology of the iron ores of the Lake Superior region in the United States, *in* Ore deposits of the United States, 1933–1967 (Graton–Sales Volume), V. 1: New York, Am. Inst. Mining, Metall. and Petroleum Engineers, p. 489–506, illus., tables, 1968.

The iron ores include soft ore, hard ore, conglomerate ore, and siliceous ore. The soft ores, the important type, are *in situ* deposits of hematite and limonite formed by leaching of silica and other gangue materials. Hard-ore deposits occur where hematite or magnetite has replaced silica in cherty iron formations by hydrothermal action. Certain stratigraphic horizons of the cherty iron formations contain sufficient iron to yield an ore-quality product after grinding and concentrating. The magnetite-rich deposits are termed magnetite-taconites which are unenriched cherty iron formation, the result of sedimentary deposition and metamorphic history. The hematite-rich formations are termed jasper ores and appear to be recrystallized iron formations in which iron, prior to recrystallization, occurred as hematite.—*from* Author's abstract

05566 **Martin, Robert A.** Further study of the Friesenhahn Cave *Peromyscus*: Southwestern Naturalist, v. 13, no. 3, p. 253–266, illus., tables, 1968.

Sixty-five fossil mandibles of mice of the genus *Peromyscus* from the late Pleistocene Friesenhahn Cave fauna of Texas were analyzed for species identification. Measurements of the fossils in comparison with series of living *Peromyscus* from Texas and adjoining states and northeastern Mexico indicate that the fossil material includes five species: *maniculatus, leucopus, gossypinus*, cf. *eremicus*, and cf. *boylii*. Apparent differences between late Pleistocene paleoecology and modern ecology are discussed; *P. pectoralis*, now one of the most common *Peromyscus* in the area, is definitely not a member of the Pleistocene cave fauna.—VMJ

05564 **Martinsson, Anders.** An Appalachian species of the Silurian ostracode genus *Craspedobolbina*: Geol. Fören. Stockholm Förh., v. 90, pt. 2, no. 533, p. 302–308, illus., 1968.

Beyrichia kirki Ulrich and Bassler 1923 and *B. lakemontensis* from the *Mastigobolbina typus* Zone (Upper Clinton Formation, late Llandoverian) in Pennsylvania are revised and redescribed as one species, *Craspedobolbina kirki* (Ulrich and Bassler 1923). This is the only species of *Craspedobolbina* from America described hitherto. Its sexual dimorphism is manifest not only in the formation of a crumina but also in a paracruminal inflation of the syllobium. Far-reaching reconstructive retouching of the figures accompanying the original description has prevented earlier recognition of this species as a *Craspedobolbina*.—Author's abstract

05252 **Mason, Brian.** Memorial to Mark Chance Bandy (1900–1963): Geol. Soc. America Proc. 1966, p. 165–168, portrait, 1968.

Mason, D. *See* Mamet, B. L. 05508

05660 **Matson, Robert E.; Dahl, Gardar G., Jr.; Blumer, John W.** Strippable coal deposits on state land, Powder River County, Montana: Montana Bur. Mines and Geology Bull. 69, 81 p., illus., tables, 1968.

The mapped strippable coal deposits lie in the lower part of the Tongue River Member of the Fort Union Formation. Of the seven major and some local coal beds mapped, eight localities in three beds are suitable for strip mining. The strippable deposits all consist of beds at least 12 feet thick; on Otter Creek the coal in the Knoblock bed reaches a thickness of 47 feet. Rank of the coal ranges from lignite to subbituminous C; coal has a low ash and sulfur content. Overburden consists mainly of friable sandstone, soft gray claystone, and a few thin beds of well-indurated sandstone and limestone. Each strippable deposit was mapped to a limit 150 feet of overburden as maximum. Strippable reserves total 1,472,000,000 tons and occur in the Broadus, Knoblock, and Pawnee coal beds.—*from* Authors' abstract

05203 **Mattick, Robert E.** Seismic-refraction profiles across six canyons in the Wasatch Range near Salt Lake City, Utah, *in* Geological Survey research 1968, Chap. D: U.S. Geol. Survey Prof. Paper 600-D, p. D255-D257, illus., 1968.

Thickness of fill in six narrow canyons east of Salt Lake City, Utah, was determined by seismic-refraction profiling. The reciprocal method of shallow seismic-refraction interpretation proved a simple and reliable technique for depth computations where conventional seismic interpretation techniques were not applicable. A maximum fill thickness of about 250 feet and a minimum of about five feet were determined in Little Cottonwood and Big Cottonwood Canyons, respectively.—Author's abstract

05505 **Mayr, U.** Subdivisions and correlations of the Tully Formation (Upper Devonian) in New York State and Pennsylvania on the basis of a statistical and stratigraphical analysis of selected conodonts [abs.]: Bull. Canadian Petroleum Geology, v. 16, no. 3, p. 421, 1968.

Mays, R. E. *See* Lee, Donald E. 05195

McCallum, Malcolm E. *See* Chronic, John. 00019

05685 **McCammon, Richard B.** Multiple component analysis and its application in classification of environments: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 11, pt. 1, p. 2178-2196, illus., 1968.

Multiple component analysis of multivariate data from sample collections classifies environments on the assumption that the number of distinguishable environments is about equal to the number of positively correlated groups of variables, and that two positively correlated variables reach maximum development in a similar environment. Each group is a "component" and each sample is classified according to the component it most resembles. Other statistical methods restrict the number of samples to about 200 because of computer limitations, but the multiple component method restricts only the number of variables. Using Bahama Bank samples, the various statistical methods are illustrated and results are compared.—BHK

05601 **McCann, Thomas P.; Privrasky, Norman C.; Stead, Frederick L.; Wilson, James E.** Possibilities for disposal of industrial wastes in subsurface rocks on north flank of Appalachian basin in New York, *in* Subsurface disposal in geologic basins—A study of reservoir strata: Am. Assoc. Petroleum Geologists Mem. 10, p. 43-92, illus., tables, 1968.

Potential reservoirs are the Cambrian Potsdam and Theresa Sandstones. The Potsdam has an average thickness of about 100 feet with a maximum of 410 feet; the Theresa thickness ranges from zero to 1,500 feet. Drilling depths to the Potsdam are from 1,000 to 12,600 feet. Other possible sandstone reservoirs are present in the Silurian and Devonian, but have less potential. Salt beds in Silurian rocks at depths between 500 and 4,000 feet offer sites for storage cavities. Shale sections suitable for storage of grouted waste in hydraulically produced fractures are present in Upper Devonian and Upper Ordovician strata. There are thinner sections of possible interest in the Silurian and Middle Ordovician.—*from* Authors' abstract

05354 **McConnel, Roger H.; Anderson, Roy A.** The Metaline district, Washington, *in* Ore deposits of the United States, 1933-1967 (Graton-Sales Volume), V. 2: New York, Am. Inst. Mining, Metall. and Petroleum Engineers, p. 1460-1480, illus., tables, 1968.

The Cambrian Metaline Formation contains the lead-zinc mineralization. The ore is in a carbonaceous, irregularly siliceous breccia of sedimentary and diagenetic origin, locally called the "Josephine Horizon". The marked tendency for the sphalerite and galena to be disseminated mainly in the dark breccia matrix, and other features, suggests that the sulfides were deposited contemporaneously with the sediments. Commonly, however, veins and vague veinlets and patches of white quartz, usually carrying coarse sphalerite and sometimes galena, cross cut all rock types. This suggests that minerals originally in sedimentary rock later became mobilized and redeposited as white quartz and coarse grained sulfides. In part,

this "metamorphism" is one of the effects produced during or shortly after local Cretaceous intrusion.—*from* Authors' abstract

00006 **McConnell, R. B.** The association of granites with zones of stress and shearing: Geol. Soc. America Bull., v. 80, no. 1, p. 115–120, illus., 1969.

Recent work by Brooks (1967) north of Georgian Bay, Ontario, has indicated that the Grenville Front was a zone of sinistral shear in Grenville time during an orogeny genetically responsible for Killarnean granitization by "shear melting" due to energy released by intense plastic distortion. These phenomena are compared with zones of intense Precambrian shearing in Tanzania ascribed by McConnell (1951) to deep-seated dextral shearing during orogeny considered to have generated metamorphism and granitization by raising of pressure–temperature conditions by orogenic stress. Lugeon (1930) has attributed post-tectonic granitization in the root zone of the Alps to intensified stress, late in orogeny, that caused conversion of mechanical to thermal energy. Experimental studies by Tuttle and Bowen (1958) suggest physico-chemical support for such interpretations of association of anatectic granites with intense tectonism.—*from* Author's abstract

05677 **McDonald, Barrie C.** Deglaciation and differential postglacial rebound in the Appalachian region of southeastern Quebec: Jour. Geology, v. 76, no. 6, p. 664–677, illus., table, 1968.

Deglaciation occurred between 12,000 and 13,000 years B.P., by northwestward retreat of an active ice front. The retreating ice blocked the normal drainage, forming a series of proglacial lakes whose shorelines are now tilted up to the northwest as much as 3.8 feet per mile. The lakes were succeeded by the Champlain Sea; its shorelines are now as high as 540 feet above present sea level. Champlain Sea fossils, dated as about 11,500 to 12,000 years old, suggest the sea was partly contemporaneous with Glacial Lake Iroquois and the Two Creeks Interstadial.—DRM

McEvilly, T. V. *See* Bolt, B. A. 05458

05731 **McGauhey, P. H.** Engineering management of water quality: New York, McGraw-Hill Book Co., 295 p., illus., tables, 1968.

When used as text material, this book should help the sanitary engineer, lay the ground work for more conventional technical courses, and develop an understanding of the place of water-quality control in water-resources management; it should also encourage the student to delve into other aspects of the problem. For the practicing engineer and other readers, attention is directed to recent changes in policies, and broad systems concepts with review of current technology and future possibilities. The 21 chapters include fundamental concepts, quality interchanges and changes, refractory compounds as a factor, eutrophication, aspects of management, reclamation, disposal of wastes, systems, and a summary of the status of water-quality management.—MCM

McGugan, Alan. *See* Logan, Alan. 05686

05473 **McIntosh, R. A.; Wardlaw, N. C.** Barren halite bodies in the sylvinite mining zone at Esterhazy, Saskatchewan: Canadian Jour. Earth Sci., v. 5, no. 5, p. 1221–1238, illus., tables, 1968.

The potash-sylvinite zone at Esterhazy contains well-defined but irregular bodies of halite called salt horses. There is significantly more bromide in both halite and sylvite in the horses than in adjacent ore beds, whereas rubidium in sylvite is not significantly different. Details of stratification, principally layers of clay–carbonate, can be traced from normal ore sections through the smaller salt horses, which suggest that they formed either contemporaneously with the ore beds or by later modification of ore beds without complete destruction of primary layering. It is suggested that salt horses formed by localized leaching of sylvite from ore beds by brines saturated with NaCl; some halite would be precipitated as the sylvite dissolved. The higher bromide of salt horses may be a means to differentiate between a barren hole due to a salt horse and one due to nondeposition of ore.—*from* Authors' abstract

0525y **McKague, H. Lawrence.** The serpentine mineral group: Gems and Gemology, v. 12, no. 11, p. 326–332, 356, illus., tables, 1968.

Serpentine, the most common jade substitute, is a mineral group consisting of antigorite, lizardite and chrysotile. Because of their nearly identical chemical composition, these minerals have similar physical properties; some of the more common varietal names, along with a description are tabulated. Most varieties have been shown to be nonserpentine minerals, mixtures of the three recognized in the group, or slight variations in texture or color of each. Structure of the three is described. Serpentinites, rock consisting primarily of serpentine minerals, have two distinctive origins: from alteration of ferromagnesian igneous rock and from alteration of carbonate sedimentary rocks rich in Mg. The serpentinization is discussed briefly. Serpentinites that are chiefly antigorite have the durability and beauty required for gems.—GDC

05752 **McKee, Edwin H.** Geologic map of the Spencer Hot Springs quadrangle, Lander County, Nevada: U.S. Geol. Survey Geol. Quad. Map GQ–770, scale 1:62,500, section, 1968.

05757 **McKelvey, V. E.** Objectives and measures of minerals policies, *in* CENTO symposium on development and utilization of mineral resources, Karachi, Pakistan, 1968: Ankara, Turkey, Central Treaty Organization, p. 157–172, 1968.

Metals, nonmetals, energy, and water are the key resources for an industrial society. Minerals can be produced for export, but it is in their internal use that they make their greatest contribution especially in developing countries. The starting of new mineral industries, finishing semimanufactures to stimulate demand for local raw materials, and domestic industries that require limited skills and capital (ceramics, glass, construction materials and certain chemicals) can lead to development of processing and refining industries and eventually to manufacture of finished goods. Government can be a dynamic agent by stimulating exploration and development, helping to expand and capitalize on infrastructures, and encouraging growth of internal industries that utilize indigeneous resources. Mineral policies are complex and take different forms depending on resource base, system of government, and stage of development.—*from* Author's summary

McKinley, Harold L. *See* Gray, Raymond F. 05359

05232 **Mead, Cynthia W.; Mrose, Mary E.** Solving problems in phosphate mineralogy with the electron probe, *in* Geological Survey research 1968, Chap. D: U.S. Geol. Survey Prof. Paper 600–D, p. D204–D206, illus., tables, 1968.

Qualitative and quantitative electron-probe analyses of nonconducting minerals with single-crystal and powder diffraction X-ray data have been used successfully to solve several problems in phosphate mineralogy. Formulas of calcioferrite from Battenburg, Bavaria, and montgomeryite from Fairfield, Utah—minerals inferred to be isostructural on basis of powder patterns—have been established by quantitative electron-probe analysis. Type zincian rockbridgeite from Maxedo, Portugal, has been shown to be a mixture of zincian lipscombite and zincian rockbridgeite. Electron-probe spectrometer traces with quantitative determinations of P and S led to identification of a mineral from Butte, Mont., as hinsdalite. Qualitative analysis of a white mineral from Västanä, Sweden, confirmed it has a composition similar to pink orthorhombic attakolite from the same locality and therefore is its monoclinic dimorph.—*from* Authors' abstract

Meagher, E. P. *See* Gibbs, G. V. 05645

05292 **Medlin, W. L.** Natural thermoluminescence of Cretaceous limestones in terms of alpha activity: Geochim. et Cosmochim. Acta, v. 32, no. 11, p. 1165–1176, illus., 1968.

Thermoluminescent dating cannot be used in limestones whose thermoluminescent growth has reached saturation. This paper investigates whether thermoluminescent buildup has reached saturation in typical Cretaceous limestones. Natural thermoluminescence was measured in terms of α-activity in single limestone beds

with negligible variations in thermoluminescent properties. Four beds were selected in which α-activity varied by a factor of two or more, and natural thermoluminescence was determined in terms of α-activity in samples from each bed and plotted against alpha count. Results showed that natural thermoluminescence was independent of α-activity for all four beds, which is interpreted to mean that thermoluminescent buildup has reached saturation in average limestones of Cretaceous age; and that growth of the 600°K peak has been influenced by temperature, and saturation has occurred without complete filling of traps.—DBV

Meisler, Harold. *See* Clark, Glenn A. 05640

Melancon, Paul E. *See* Kelley, Vincent C. 05390

Mello, James F. *See* Gibson, Thomas G. 05234

05532 **Melvin, R. L.** The surficial geology of Ben Lomond area, Saint John and Kings Counties, New Brunswick [abs.]*f* Bull. Canadian Petroleum Geology, v. 16, no. 3, p. 420, 1968.

Merchant, J. S. *See* Radabaugh, R. E. 05401

05277 **Merrill, Ronald T.** A possible source for the coercivity of ilmenite-hematite minerals: Jour. Geomagnetism and Geoelectricity, v. 20, no. 3, p. 181–185, 1968.

The coercivity of pure hematite is probably derived from magnetostrictive anisotropy associated with defects; that of ilmenohematites is larger than in pure hematite and probably is derived from magnetostrictive anisotropy associated with exsolution and defects. Any adequate theory for TRM will have to consider the likelihood that large coercivities originate in different ways in different minerals; this requires that an adequate theory for TRM must treat coercivity in a general manner or advance several theories to explain the origin of TRM in different minerals.—*from* Author's conclusions

05185 **Metzger, D. G.** The Bouse Formation (Pliocene) of the Parker-Blythe-Cibola area, Arizona and California, *in* Geological Survey research 1968, Chap. D: U.S. Geol. Survey Prof. Paper 600-D, p. D126–D136, illus., table, 1968.

A marine to brackish-water deposit of Pliocene age, older than the Pliocene and Quaternary deposits of the Colorado River in the Parker-Blythe-Cibola-area Arizona and California, is here named the Bouse Formation. It is primarily a subsurface formation, and is composed of a basal limestone and interbedded clay, silt, and sand, and a tufa. The greatest known subsurface thickness is 767 feet, whereas the greatest exposed thickness is 215 feet. The Bouse Formation contains foraminifers, mollusks, ostracodes, charophytes, and barnacles, although the number of species is small. The Bouse Formation was deposited in an embayment of the Gulf of California; however, the limited faunas prevent a correlation of the Bouse with marine deposits of the Imperial Valley.—Author's abstract

05351 **Meyer, Charles; Shea, Edward P.; Goddard, Charles C., Jr.** (and others). Ore deposits at Butte, Montana, *in* Ore deposits of the United States, 1933-1967 (Graton-Sales Volume), V. 2: New York, Am. Inst. Mining, Metall. and Petroleum Engineers, p. 1373–1416, illus., tables, 1968.

The Boulder batholith is a composite intrusive in which the Butte quartz monzonite is the dominant rock; the ore occurs in shoots along veins. The mineralization is arranged roughly in a concentric zone of zinc and manganese around a central zone of copper. Quartz-molybdenite veinlets are slightly offset and are earlier structurally. Sericite-biotite-K-feldspar alteration envelopes, containing up to 2 percent copper, are present on some of the quartz-molybdenite veinlets in deep zones. These envelopes contrast sharply mineralogically and chemically with the later sericitic and argillic alteration envelopes around Main Stage veins. K-Ar ratios indicate that they may be older by about 4 m.y.—*from* Authors' abstract

05266 **Michigan Basin Geological Society; Liberty, Bruce A.; Shelden, Frank D.** (and others). The geology of Manitoulin Island, annual field excursion, 1968: [Lansing, Mich., Michigan Geol. Survey] 101 p., illus., tables, 1968.

This guidebook, dedicated to F. Wells Terwilliger, is for a second trip to Manitoulin Island in Lake Huron, the first having been in 1954. The eleven papers (cited separately) deal with various aspects of the geology of the island; a road log for a two-day field trip contains 27 stops for a trip about 175 miles long. Various formations are described, from Precambrian to Silurian, with a great unconformity between the Precambrian and Ordovician.—HRC

05647 **Middlemost, Eric A. K.; Romey, William D.** A graphic story of magmatic differentiation: Lithos, v. 1, no. 3, p. 242–263, illus., 1968.

The processes of magmatic differentiation can be subdivided roughly into those that operate (1) at the time of magma formation, (2) while a magma is in transit, (3) during the emplacement of a magma, and (4) when a body of magma is at rest. Many different variables, some of which are listed here, determine what processes will be dominant at any particular stage during the evolution and crystallization of a magma. A check-list of factors that may affect the crystallization history of a magma will assist petrologists in searching for models to explain the genesis of igneous rock units interpreted as consanguineous.—Authors' abstract

Miller, James F. *See* Clark, David L. 00014

05440 **Milne, V. G.** Geology of the Black River area, District of Thunder Bay: Ontario Dept. Mines Geol. Rept. 72, 68 p., illus., tables, geol. maps, 1968.

Consolidated rocks of the Black River area are Precambrian; much of the area is blanketed by thick deposits of Pleistocene gravel, sand, and clay. A mafic metavolcanic formation has been interpreted as the oldest formation; the rocks appear to form the lowermost horizon of a sequence which grades into mixed metavolcanic, pyroclastic rocks and metasediments, and then into a thick succession of metasediments. These rocks have been intruded by metagabbro, serpentine, and gneiss, and have been folded about ENE- and NNW-trending axes; after metamorphism and folding, they were intruded by large plutons and later by swarms of diabase dikes. Small showings of zinc and lead-zinc are present in the mafic metavolcanic rocks, but of greater economic interest are copper-nickel showings in the pyroclastic-silicic metavolcanic formations adjacent to the mafic metavolcanic unit.—*from* Author's abstract

05577 **Milner, William; Donaldson, Alan.** Vadis field, Lewis and Gilmer Counties, West Virginia: West Virginia Acad. Sci. Proc. 1968, v. 40, p. 231–235, illus., 1968.

Reservoir rock for oil in the Vadis field, W. Va., is the Loyalhanna Member of the Mississippian Greenbrier Limestone. Thickness trends observed on isopach maps of the Loyalhanna Member and Greenbrier Limestone are interpreted to mark the position of valleys incised by streams on the pre-Greenbrier erosional surface. Reservoir rock apparently was deposited as valley fill during westward transgression of the Greenbrier sea. The paleoslope probably enabled down-dip migration of brines which increased porosity of the original calcarenites by dolomitization, followed by up-dip migration of the oil and gas from laterallly adjacent organic-rich calcilutites. Adjustment of oil and gas to later folding and jointing of the rocks probably accounts for the gas at the crest of the Wolf Summit anticline and oil along its flanks.—*from* Authors' abstract

Minihan, Edward. *See* Oxley, Marvin L. 05424

05694 **Mintz, Leigh W.** Echinoids of the Mesozoic families Collyritidae D'Orbigny, 1853 and Disasteridae Gras, 1848: Jour. Paleontology, v. 42, no. 5, p. 1272–1288, illus., 1968.

Disasteroid echinoids are members of the superorder Atelostomata characterized by a disjunct apical system. Recent studies have demonstrated that primitive disasteroids are endocyclic and that the transition to exocyclic forms can be traced

in several lineages. The best documentation of the regular–irregular transition is within the Collyritidae. The Disasteridae as previously conceived is polyphyletic because the non–intercalary apical system evolved at least four times. The classification of the Atelostomata is revised to include these orders: Galeropygoida, new; Cassiduloida; Disasteroida, new; Holasteroida; Pourtalesioida, new; Spatangoida. Disasteroida includes the families: Pygorhytidae; Collyritidae; Disasteridae; Tithoniidae, new; Acrolusiidae, new.—*from* Author's abstract

05526 **Money, P. L.** The Precambrian geology of the Needle Falls area, Saskatchewan [abs.]: Bull. Canadian Petroleum Geology, v. 16, no. 3, p. 416, 1968.

00038 **Moore, Carl A.** The occurrence of oil in sedimentary basins, Pts. 1–2: World Oil, v. 168, no. 1, p. 69–79; v. 168, no. 2, p. 42–48, illus., 1969.

The paper briefly summarizes basin configurations, sedimentary environments, and some principles of oil occurrence. Oil generally occurs in areas of rapid basin subsidence, thick sedimentation, or adjacent to basin sinks. An evaluation of the producing potential of a basin must utilize data such as the sedimentologic and tectonic history of the basin, sediment thickness and facies distribution, and time of oil accumulation as related to time of structural deformation.—MWR

00031 **Moore, Carleton B.; Gibson, Everett K.** Nitrogen abundances in chondritic meteorites: Science, v. 163, no. 3863, p. 174–176, illus., table, 1969.

Carrier–gas fusion extractions of total nitrogen in 22 chondritic meteorites indicate a wide variation in total nitrogen contents, ranging from 660 parts per million for an enstatite chondrite to 18 parts per million for an ordinary chondrite. Total nitrogen and total carbon contents of individual chondrites do not show a positive correlation.—Authors' abstract

05237 **Moore, David G.; Palmer, Harold D.** Offshore seismic reflection surveys, *in* Civil engineering in the oceans—ASCE Conf., San Francisco, Calif., 1967, Proc.: [New York] Am. Soc. Civil Engineers, p. 789–806, illus., 1968.

Several new developments in energy sources and survey instrumentation permit continuous reflection profiles of subsurface structure to be recorded graphically aboard a vessel underway at a reasonable survey speed. Basic componenets of the system are: an underwater energy source, hydrophones, a filter–amplifier combination, and a graphic recorder. Factors affecting quality of records may be those resulting from variations in geology of the investigated locality, or in electronic and mechanical components of the system itself. Interpretation of records requires knowledge of the geology of the survey area and of the profiling system's capabilities and limitations; from the records it is possible to construct detailed geologic sections. The method is effective when used in conjunction with borings in foundation studies and location of potential geological hazards on possible construction sites, and also in planning and control of dredging operations.—MCM

Moore, John E. *See* Schoff, Stuart L. 05174

00020 **Moore, Willard S.** Measurement of Ra–228 and Th–228 in sea water: Jour. Geophys. Research, v. 74, no. 2, p. 694–704, illus., tables, 1969.

The first measurements of Ra–228 in the ocean are reported, and the analytical methods of determining Ra–228 and Th–228 are discussed. Measurable excesses of both Ra–228 and Th–228 relative to the Th–232 exist in the ocean. Ra–228 should prove a valuable tracer for studies of water movements. Its 6.7–year half–life makes it applicable to processes with a time scale of 3–25 years.—Author's abstract

05263 **Moores, E. M.; Scott, R. B.; Lumsden, W. W.** Tertiary tectonics of the White Pine–Grant Range region, east–central Nevada, and some regional implications: Geol. Soc. America Bull., v. 79, no. 12, p. 1703–1726, illus., tables, geol. map, 1968.

In a 400 sq mile area, east of the Antler orogenic front and west of the Sevier–Laramide thrust belt, about 20,000 feet of Paleozoic rocks are overlain by 3,000–

5,000 feet of Eocene–Oligocene sedimentary and volcanic rocks, and 0–10,000 feet of Miocene–Pliocene sedimentary rocks. Prominent north–trending folds in the Paleozoic and early Tertiary strata probably reflect a period of post–volcanic crustal shortening in this area. The folds are cut by a series of low–angle faults placing younger rocks over older, and relations suggest that movement of these faults was probably nearly surficial. Deposition of Miocene–Pliocene sediments was accompanied by emplacement of large gravity slide masses of older rocks into the sedimentary basin.—EHP

00039 **Morelock, Jack.** Shear strength and stability of continental slope deposits, western Gulf of Mexico: Jour. Geophys. Research, v. 74, no. 2, p. 465–482, illus., table, 1969.

Sediments from the continental slope in the western Gulf of Mexico were tested to determine shear strength, stability, and consolidation characteristics. Although the topography of parts of the continental slope has been attributed to local slumping of unconsolidated and unstable marine sediments, no evidence was found to indicate instability of the sediments in the present environment. Continental slope sediments tested exhibit apparent overconsolidation and relatively high values of shear strength. This stability is assumed to be the result of low deposition rates and incipient cementation of mineral grains. Paleontological evidence indicates that some sediments in Campeche canyon were deposited as the result of slumping and turbidity currents during the Pleistocene. Test results show, however, that these sediments are stable in the present environment.—*from* Author's abstract

Morris, Gerald B. *See* Helmberger, Donald V. 00040

Morris, H. T. *See* Shepard, W. M. 05485

05374 **Morris, Hal T.** The main Tintic mining district, Utah, *in* Ore deposits of the United States, 1933–1967 (Graton–Sales Volume), V. 2: New York, Am. Inst. Mining, Metall. and Petroleum Engineers, p. 1043–1073, illus., tables, 1968.

The Tintic district has produced silver, lead, gold, copper, zinc, and other minerals; more than 90 percent of the ore has come from large, irregular orebodies that have replaced folded and faulted limestone and dolomite. Replacement and fissure veins are of lesser importance. More than 10,000 feet of sedimentary rock from Precambrian to Mississippian in age are present. They are partly overlain by Eocene volcanic rocks, and all of these are locally concealed in part by Pliocene and Quaternary alluvium. The Eocene and older rocks are cut by dikes and sills and small quartz monzonite stocks which are genetically related to the ore deposits. The district is inactive except for halloysite clay mining.—*from* Author's abstract

05595 **Morris, W. V.** Hydrology education in Canada [with French and Spanish abs.], *in* Water for peace—Internat. Conf., Washington, D.C., 1967—V. 5, Organizing for water problems: Washington, D.C., U.S. Govt. Printing Office, p. 886–889, 1968.

Based mainly on the results of surveys made in 1962 and 1965, the science of hydrology in Canada has been related almost entirely to practical problems of water resources development; hydrologists are usually trained on the job. Some university courses include hydrology but the subject is not taught as an independent discipline. The Water Resources Branch of the Department of Energy, Mines and Resources has been conducting and managing its own courses for new staff members. A few graduate schools offer courses in hydrology, but to civil engineering students only. Interest stimulated by the International Hydrologic Decade has contributed to education by two Canadian seminars sponsored by the Canadian National Committee for the decade.—MCM

05671 **Mosher, L. Cameron.** Triassic conodonts from western North America and Europe and their correlation: Jour. Paleontology, v. 42, no. 4, p. 895–946, illus., tables, 1968.

Seven conodont faunal assemblages are recognized in upper Scythic, Anisic, Ladinic, and lower Carnic strata in western North America; six faunal assemblages are recognized from strata of approximately the same interval in Europe. The faunas

consist of 17 genera (7 new) and 62 species (17 new). Although apparently limited in their value for intercontinental correlation, these assemblages may be useful for intraregional stratigraphic work. Three new conodont assemblage zones are recognized in the upper Carnic and Noric of both Europe and North America, which seem to have worldwide validity: *Paragondolella polygnathiformis* Assemblage Zone (upper Carnic), *Epigondollella abneptis* Assemblage Zone (lower Noric), and *E. bidentata* Assemblage Zone (upper Noric).—*from* Author's abstract

05672 **Mosher, L. Cameron.** Evolution of Triassic platform conodonts: Jour. Paleontology, v. 42, no. 4, p. 947–954, illus., 1968.

Evolution of Triassic platform conodonts proceeded along three morphologically similar but apparently unrelated lineages: a gondolellid stock, members of which possess definite platforms in earliest growth stages; a neospathodid stock, members of which lack platforms in earliest growth stages; and gladigondolellid stock. Continuous stratigraphic sequences from both [western] North America and Europe demonstrate the patterns of evolution in neospathodid stock which produced a succession of species having great biostratigraphic usefulness in Upper Triassic rocks. Because neospathodid species often comprise the majority of specimens in a sample, with all growth stages represented, these elements may have been the only conodonts in the apparatuses of the animals bearing them. Gondolellid elements, however, probably were part of a diversely constituted apparatus.—*from* Author's abstract

05393 **Motica, J. E.** Geology and uranium–vanadium deposits in the Uravan mineral belt, southwestern Colorado, *in* Ore deposits of the United States, 1933–1967 (Graton–Sales Volume), V. 1: New York, Am. Inst. Mining, Metall. and Petroleum Engineers, p. 805–813, illus., 1968.

The Uravan mineral belt is a narrow elongate area in which the uranium–vanadium deposits in the Salt Wash Member of the Morrison Formation have a closer spacing, larger size, and higher grade than those in adjoining areas. The ore is in sandstone lenses formed by aggrading,braided streams. The lenses are as much as one mile wide and 50 feet thick, and can be traced for several miles. Favorable areas are identified by (1) host sandstone thickness over 30 feet, (2) presence of carbonaceous material in the sandstone, and (3) gray mudstones and clays associated with the host sandstone. The ore minerals are believed to have been precipitated from laterally migrating solutions. There is no apparent genetic relationship between ore deposits and tectonic structural features.—*from* Author's abstract

05179 **Mower, R. W.** Ground–water discharge toward Great Salt Lake through valley fill in the Jordan Valley, Utah, *in* Geological Survey research 1968, Chap. D: U.S. Geol. Survey Prof. Paper 600–D, p. D71–D74, illus., table, 1968.

Ground water in the northern part of the Jordan Valley is principally under artesian conditions in valley fill of Quaternary age consisting of clay, silt, and sand. The water is moving generally toward the southeast shore of Great Salt Lake. The computed quantity of water discharging into Great Salt Lake from the valley fill in the northern part of the Jordan Valley is estimated to be a maximum of 7,000 acre–feet per year.—Author's abstract

05396 **Mrak, Vernon A.** Uranium deposits in the Eocene sandstones of the Powder River basin, Wyoming, *in* Ore deposits of the United States, 1933–1967 (Graton–Sales Volume), V. 1: New York, Am. Inst. Mining, Metall. and Petroleum Engineers, p. 838–848, illus., table, 1968.

Uranium occurrences in the Powder River basin are many and widespread, but most are small and difficult to mine. The ore occurs in the earliest Eocene portion of the Wasatch Formation in redbeds or altered sandstones. The Monument Hill district had produced 91 percent of the ore in the region. The source of the uranium is presumed to have been Oligocene, Miocene, and perhaps Pliocene tuffaceous rocks that once overlay the area. Joints, fractures, and permeable beds or zones were the passageways for the migration of the uraniferous waters from the overlying beds to the Eocene host rocks.—*from* Author's abstract

Mrose, Mary E. *See* Mead, Cynthia W. 05232

05186 **Mudge, Melville R.; Sheppard, Richard A.** Provenance of igneous rocks in Cretaceous conglomerates in northwestern Montana, *in* Geological Survey research 1968, Chap. D: U.S. Geol. Survey Prof. Paper 600-D, p. D137-D146, illus., 1968.

Igneous pebbles and cobbles are in conglomerates of four Cretaceous units in and near the Sun River area. These conglomerates occur in the Kootenai Formation, Vaughn Member of the Blackleaf Formation, Two Medicine Formation, and in the Horsethief Sandstone. Both plutonic and volcanic rocks are in the Kootenai, whereas only volcanic rocks are in the younger conglomerates. Study of these sedimentary deposits indicates that, except for the Kootenai, volcanism was contemporaneous with deposition of each formation. Igneous rocks in the Kootenai conglomerates are probably very late Jurassic in age. The source of igneous rocks in Lower Cretaceous rocks was west of the Sun River area. The source for some of the Upper Cretaceous igneous-pebble conglomerates was south of the Sun River area, whereas for other conglomerates it was west of the area.—*from* Authors' abstract

Muffler, L. J. P. *See* Clayton, R. N. 05269

Muncaster, Neil K. *See* Wallace, Stewart R. 05400

05340 **Mungan, Necmettin.** Permeability reduction due to salinity changes: Jour. Canadian Petroleum Technology, v. 7, no. 3, p. 113-117, illus., table, 1968.

X-ray diffraction, base exchange studies, and core flood tests with changing salinity showed that reduction of permeability of Berea Sandstone is related to exchangeable cations on clays and to particulate morphology. The clay crystals, containing primarily Ca, Mg, and K, but little Na, are held together tightly so that no swelling damage occurs with flow of distilled water; with NaCl solution, the clays expand by hydration of sodium, weakening the bonds so that subsequent distilled water removes the double layer unless the clays are first exposed to divalent Ca or trivalent Al cations. X-ray diffraction showed many of the clay crystals to be micro aggregates, grown contemporaneously and so interpenetrated that they will not separate under moderate conditions. Solutions with the same osmotic pressures as the NaCl solution used were found to cause no permeability damage when followed by distilled water flow.—GDC

Munro, A. H. *See* Krige, D. G. 05225

Murphy, Anabeth. *See* Rinehart, John S. 00047

05414 **Murphy, John E.; Ohle, Ernest L.** The Iron Mountain mine, Iron Mountain Missouri, *in* Ore deposits of the United States, 1933-1967 (Graton-Sales Volume), V. 1: New York, Am. Inst. Mining, Metall. and Petroleum Engineers, , p. 287-302, illus., 1968.

Hematite and magnetite occur principally as open-space filling in fractured and brecciated andesite porphyry with very minor replacement of the wall rocks. The enclosing rocks are Precambrian dacite, rhyolite, and andesite flows aggregating about 2,000 feet in thickness. All of the ore is in andesite; mineralization is Precambrian. The shape of the bodies, the breccia character of the ore, and the gangue mineralogy are unique. One body is dome-shaped with a tendency to develop mineralized concentric shells, the other is an elongated lens in plan but hook-shaped in section; both have strong linear elements. No explanation for the origin of the structures and tension breccias is completely satisfactory. Hematite is the main ore mineral. The ore may result from injection of an iron-rich melt or formation by a high-temperature, water-rich solution.—*from* Authors' abstract

05469 **Murthy, G. S.; Fahrig, W. F.; Jones, D. L.** The paleomagnetism of the Michikamau anorthositic intrusion, Labrador: Canadian Jour. Earth Sci., v. 5, no. 5, p. 1139-1144, illus., tables, 1968.

Twenty-nine oriented cores were collected from six sites in the Michikamau Intrusion which has been previously dated at 1400 m.y. by the K-Ar method. A fold test was applied to the paleomagnetic results after alternating magnetic field demagnetization. Results suggest that the magnetization was acquired with the rocks in their present attitudes. The stability of the magnetization was well tested and the observed magnetization is thought to be thermoremanent and represents the direction of the Earth's field at the time of the intrusion's formation. The paleomagnetic pole position for the intrusion lies at 0.5° S, 144.7° W, with A_{95} = 5.6°. Although comparisons are difficult, a comparison with recently published results from well-dated rocks from Colorado-Wyoming suggests there have been no large relative movements between this region and Labrador in the last 1400 million years.—*from* Authors' abstract

Myers, A. T. *See* Wahlberg, J. S. 05233

Mygdal, Karl. *See* Hardin, George C., Jr. 05718

00004 **Naeser, C. W.; Paul, H.** Fission-track annealing in apatite and sphene: Jour. Geophys. Research, v. 74, no. 2, p. 705-710, illus., 1969.

Study of the annealing characteristics of fission-tracks in sphene and fluorapatite shows that all tracks will be annealed out in 1 hour at 350°C for fluorapatite and 625°C for sphene. Extrapolation of the experimentally determined annealing temperatures suggest that all tracks will disappear in 10^6 years at 170°C for fluorapatite and 420°C for sphene. The experiments were made at atmospheric pressure, but increasing the pressure to 2 kb of water had no additional effect on the annealing of apatite. Concordant sphene and apatite fission-track ages were determined at Magnet Cove, Ark. (99±10 m.y.), and Eldora, Colo. (Bryan Mountain stock 73±7 m.y.). Discordant sphene and apatite ages were determined on the Tishomingo granite of southern Oklahoma (sphene=1330 m.y., apatite=590 m.y.) and the Boulder Creek granite of Colorado (sphene=1200 m.y. apatite=75 m.y.).—Authors' abstract

05278 **Nagata, T.; Carleton, B. J.** Notes on piezo-remanent magnetization of igneous rocks: Jour. Geomagnetism and Geoelectricity, v. 20, no. 3, p. 115-127, illus., tables, 1968.

Experimental studies of acquisition of piezo-remanent magnetization (PRM) of igneous rocks under uniaxial compression indicate that the rate of acquisition is several times as large as that of assemblages of magnetic minerals. This is in contrast to the fact that rate of decrease of magnetic susceptibility owing to increase of uniaxial compression in rocks is about one order smaller than that in magnetic minerals. The rate of acquisition of PRM is larger in a smaller than in a larger magnetic field, and is larger for rock samples which are magnetically harder. It is qualitatively shown that these results can be explained consistently on the basis of a simple model of configuration of magnetic domains of magnetic minerals under the effect of inverse magnetostriction.—*from* Authors' abstract

Nagata, T. *See* Kono, M. 05341

05196 **Nakagawa, H. M.; Harms, T. F.** Atomic absorption determination of cadmium in geologic materials, *in* Geological Survey research 1968, Chap. D: U.S. Geol. Survey Prof. Paper 600-D, p. D207-D209, tables, 1968.

A simple, rapid, and sensitive atomic absorption method for the determination of cadmium in rocks and soils has been developed. The sample is digested with nitric acid and the supernatant liquid atomized in an atomic absorption spectrophotometer. The method has been used to determine cadmium in soils and rocks and in minerals, such as sphalerite and zincite, with no observed interference. The results obtained compare favorably with those from colorimetric and spectrographic methods. As little as 0.2 ppm in the sample can be satisfactorily determined.—Authors' abstract

Naugler, Frederic P. *See* Grim, Paul J. 00036

05510 **Nava, David Francis.** Atomic absorption analysis for copper and zinc in iron and stony meteorites [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 29, no. 5, p. 1582-B, 1968.

Nelson, Raynor D. *See* Vey, Eben. 05207

Nimlos, Thomas J. *See* Faust, Richard A. 05610

05616 **Nininger, Robert** D. The importance of increased supplies of nuclear fuels to meet long-term world energy requirements, *in* Internat. Geol. Cong., 23d, Prague, 1968, Proc., Sec. 13, Other subjects: Prague, Academia, p. 303-316, illus., 1968.

World population may reach 6,000 million by the year 2000. If per capita energy consumption remained static energy supply would have to double. A continuing increase in the standard of living will increase per capita consumption and by large amounts in the less developed countries. Resources of petroleum and natural gas are limited; large resources of coal are not uniformly distributed and production costs will rise as more accessible and easily mined seams are exhausted. Nuclear fuels—uranium and thorium—if available in sufficient quantity, can compensate for the insufficiency of fossil fuels. Success in development of nuclear power stations economically competitive with conventional plants has far exceeded expectations and nuclear power growth has been continually underestimated.—*from* Author's abstract

Nitecki, Matthew H. *See* Solem, Alan. 05676

05210 **Noble, Donald C.** Calcium contents, Na_2O:K_2O ratios, and water contents of the Paintbrush and Timber Mountain magmas—[discussion of paper by Lipman, "Water pressures during differentiation and crystallization of some ash-flow magmas from southern Nevada", 1966]: Am. Jour. Sci., v. 266, no. 9, p. 860-864, illus., 1968.

Noble shows where the presence of calcium has a larger effect on the system than was suspected by Lipman, (ibid., v. 264, no. 10, p. 810-826, 1966) and therefore the water contents of the two units involved need not have been substantially different.—HRC

Noble, Donald C. *See* Christiansen, Robert L. 05446

05683 **Noble, Donald C.** Laminar viscous flowage structures in ash-flow tuffs from Gran Canaria, Canary Islands—A discussion: Jour. Geology, v. 76, no. 6, p. 721-723, illus., 1968.

"Gas flotation" resulting from compaction of pumice fragments is suggested as an additional mechanism by which flowage may take place in late stages of emplacement of the ash-flow tuffs of Nevada, apparently similar in essential respects to those of Gran Canaria.—REW

05486 **Nolan, T. B.; Hunt, R. N.** The Eureka mining district, Nevada, *in* Ore deposits of the United States, 1933-1967 (Graton-Sales Volume), V. 1: New York, Am. Inst. Mining, Metall. and Petroleum Engineers, p. 966-991, illus., tables, 1968.

Production of silver, lead, gold, and other metals to date has been thoroughly oxidized ore from massive replacements, fissures, manto, and pipe-like bodies—in large part from the Eldorado and Hamburg dolomites. Most came from a block of Eldorado dolomite on an overthrust plate; the lower 500-600 feet was highly shattered and became host to the ores. Recently the downdropped block has been exploited; the ores at depth are the sulfide counterpartss of those mined earlier on the footwall. The ores are attributed to the same source as the intrusive quartz diorite outcropping south of Ruby Hill. The long north-south axis of the district, its anticlinal structure, its major faults, and the distribution of the intrusives and, in their relation to the surface, the ores themselves, all suggest that erosion has not cut deep enough to expose the extent of the intrusives and the ores consequent upon them.—*from* Authors' abstract

05744 **Norris, A. W.** Reconnaissance Devonian stratigraphy of northern Yukon Territory and northwestern District of McKenzie: Canada Geol. Survey Paper 67-53, 287 p., illus., tables, 1968.

The composition, distribution, faunal assemblages, lithology and thickness of ten Devonian formations north of lat 65° and west of long 132° are described. The first five formation names are new: Michelle, limestone, dolomite, and shale in the Hart–Ogilvie Rivers area; Gossage, banded dolomites and limestones coeval with Bear Rock evaporite and breccia; Prongs Creek, shale and argillaceous limestone in Richardson Mts.; Cranswick, limestone and calcareous shale in the Snake River area; and Ogilvie, resistant carbonates. Other formations are: Hume, east of Flyaway Creek; Hare Indian, unusually thick in the Snake River area; unnamed shale, poorly exposed in Ogilvie Mts.; Canol, black shale mainly east of Richardson Mts.; and Imperial, clastics in places 6,000 feet thick. An appendix gives 10 measured sections. A correlation chart and four cross-sections are in pocket.—GDC

00022 **Norris, Roger A.; Johnson, Rockne H.** Submarine volcanic eruptions recently located in the Pacific by Sofar hydrophones: Jour. Geophys. Research, v. 74, no. 2, p. 650–664, illus., tables, 1969.

Five sources of underwater sound having volcanic characteristics have been located in the Pacific Ocean by means of the Pacific Missile Range Sofar hydrophone network. Two are in the Mariana Islands, one in the Nanpo Shoto, one in the Aleutian Islands, and one at the southeast end of the Austral seamounts. The sounds range in duration from a few seconds (explosive) to weeks (periodic low rumblings). Sonagrams of some of these events show multiple bands as do those of underwater explosions.—Authors' abstract

00002 **Nowroozi, A. A.; Kuo, J.; Ewing, M.** Solid earth and oceanic tides recorded on the ocean floor off the coast of northern California: Jour. Geophys. Research, v. 74, no. 2, p. 605–614, illus., tables, 1969.

The ocean and solid earth tide are simultaneously measured on the deep ocean floor at a depth of 3903 m off the coast of northern California. Significant spectral components are found by harmonic analysis, least squares, and convolution methods for both tides corresponding to O_1, K_1, N_2, M_2, and S_2 constituents; theoretical fluctuation of gravity and tidal residues were calculated for the same period. Gravimetric factors for resolved components of solid earth tides are estimated after approximate removal of effect of ocean tide from observed fluctuations of gravity; value for most reliable M_2 constituent is 1.126 ± 0.056 and for O_1 constituent, 1.140 ± 0.057. Phase differences between theoretical and observed fluctuation of gravity after removal of effect of oceanic tides from observed values are 5.66° for M_2 connstituent and 3.67° for O_1 constituent.—*from* Authors' abstract

05509 **Nyquist, David.** Eutrophication trends of Bear Lake, Idaho–Utah and their effect on the distribution and biological productivity of zooplankton [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 29, no. 5, p. 1560B–1561B, 1968.

05218 **O'Brian, D. T.; Weiss, A.** Practical aspects of computer methods in ore reserve analysis, *in* Ore reserve estimation and grade control—Canadian Centennial Conf., Quebec, 1967: Canadian Inst. Mining and Metallurgy Spec. Vol. 9, p. 109–113, illus., 1968; reply to discussion by M. David and R. A. Blais, ibid., p. 115, 1968.

The selection of an appropriate ore reserve computational method is often influenced by the objective. Experience has shown that there is no unique, best method for determining a given reserve; however, depending upon the objective, it is possible to distinguish satisfactory from unsatisfactory methods. Geological knowledge of mineral deposits is continually increasing, and many technological improvements are being made in sampling and mining techniques, resulting in refinement of former ore reserve methods and development of new. This paper discusses major computer methods available for determining ore reserves and introduces the mineralization inventory as an intermediate stage in ore reserve estimation.—*from* Authors' abstract

Ohle, Ernest L. *See* Murphy, John E. 05414

Okazaki, Rose. *See* Smith, Henry W. 05622

Okun, Daniel A. *See* Weiss, Charles M. 05492

Oldale, R. N. *See* Koteff, Carl. 05753

Oliver, Jack. *See* Chandler, Ramesh. 05457

05755 **Oliver, William A., Jr.** Some aspects of colony development in corals, *in* Paleobiological aspects of growth and development, a symposium: Paleont. Soc. Mem. 2 (Jour. Paleontology, v. 42, no. 5, supp.), p. 16–34, illus., tables, 1968.

Many peculiarities of growth and development in colonial metazoans are related to the fact that a true colony is a clone, composed of genetically identical individuals reproduced asexually from a single founding individual. In fossil colonies the close relationship of individuals may be difficult to prove, but it must be assumed for analysis to be meaningful. Intercolony variation, which is due to the interaction of genetic and environmental controls as in solitary organisms, may be very limited because of lack of genetic variation, but microenvironmental differences (situation within colony) may cause enough individual variation to mask the restrictive effect of genetic similarity. The number of major septa in some Devonian rugose corals shows significantly less variation, and less correlation with diameter, within colonies than within "populations" or species of colonial or solitary forms.—*from* Author's abstract

05500 **Ondrick, Charles William.** Petrography and geochemistry of the Rensselaer Graywacke, Troy, New York [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 29, no. 5, p. 1776B–1777B, 1968.

05641 **Ontario Water Resources Commission.** Ground water in Ontario, southwestern area, 1960–1963: Ontario Water Resources Comm. Ground Water Bull. 6, 489 p., illus., tables, 1968.

The southwestern area of Ontario is underlain by sedimentary rocks deposited during the Paleozoic, mostly dolomites and limestones of the Lockport, Guelph, Bass Island, Bois Blanc, Detroit River, and Delaware formations. Potable water is generally assured from the Lockport and Guelph dolomites and to a lesser degree from the other formations. Unconsolidated deposits ranging from zero to nearly 500 feet are mostly glacial drift and more recent alluvial deposits in the larger river valleys; most are excellent sources of water. Regional aquifer conditions, discussed by county or groups of counties, give some indication of their variability over the whole area. Hydrographs show water-level fluctuations in observation wells; records for water wells drilled during the period are tabulated.—MCM

05205 **Opdyke, Neil D.** The Earth's mobile crust: Sci. and Technology, no. 84, p. 46–53, illus., 1968.

In the last half-century, scientists have gathered paleontological evidence which, logically interpreted, suggests that our Earth's now separate continents were once a near-unified ensemble. Although the concept of a once coalesced land mass is both appealing and intriguing, no substantive theories existed to explain how the stolid-looking Earth could supplely rearrange its features. About six years ago, a tenable theory was proposed which has since been proved. This theory, that the sea floor is spreading, states that new material constantly exudes from ridge-like formations on the ocean's floor and moves away from its source—giving way to still newer material. Ultimately, it is reabsorbed into the Earth many thousands of kilometers distant at another undersea formation. The continents, attached as they are to the ocean's floor, get a snail-paced piggy-back ride to ever-new locations.—Editor's brief

05735 **Orlenok, V. V.** O stroyenii zemnoy kory severnoy chasti atlanticheskogo okeana po seysmicheskim dannym [with English summ.]: Okeanologiya, v. 8, no. 2, p. 245–256, illus., 1968.

Crustal structure in the North Atlantic is analyzed on the basis of seismic data obtained by foreign and Russian geophysicists. The second layer is not encountered everywhere in the area investigated; it occurs beneath the continental margin, in the deep-sea basins beneath some elevations, and under the sediments of the median ridges. This indicates that volcanic processes in the crust and upper mantle are localized in character. The nature of the second layer is discussed. The suprabasaltic and basaltic complexes are most commonly represented by two layers with different seismic velocities. The M-discontinuity is not as a rule recorded where the suprabasaltic complex is present, possibly due to its local deepening under rises and median ridges. A scheme of the sediment thickness and also one showing distribution of structural types of crust under the North Atlantic are presented.—DBV

05705 **Ormiston, Allen R.** Lower Devonian trilobites of Hercynian type from the Turkey Creek inlier, Marshall County, south-central Oklahoma: Jour. Paleontology, v. 42, no. 5, p. 1186–1199, illus., tables, 1968.

Collections from a single outcrop of a 5-ft thick limestone unit on Turkey Creek, Marshall County, Okla., include a diverse trilobite fauna consisting of a phacopid, a dalmanitid, a scutelluid, an odontopleurid, and several proetids. One species, *Reedops amsdeni*, and two subspecies, *Ceratonurus selcanus dilatus* and *Cornuproetus pictus contractus*, are new. The trilobites indicate a lower Emsian age for the unit, which cannot be correlated with previously known Lower Devonian units in Oklahoma. Both lithologically and faunally the Turkey Creek limestone unit belongs to the Hercynian magnafacies and represents an incursion of Old World Province trilobites into an area which, before and after, belonged to the Appalachian Province.—*from* Author's abstract

05761 **Orr, R. William; Pollock, Charles A.** Reference sections and correlation of Beechwood Member (North Vernon Limestone, Middle Devonian) of southern Indiana and northern Kentucky: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 11, pt. 1, p. 2257–2262, illus., 1968.

A nearly complete section of the Beechwood Member of the North Vernon Limestone, exposed in the cut on the north side of the Louisville and Nashville Railroad in the community of Clifton within Louisville, Ky., is designated the principal reference section. In terms of conodont zones, the Beechwood Member is within the *Polygnathus varcus* Zone (upper Middle Devonian). The lowermost part of the 8-ft thick limestone section contains abundant phosphatic pebbles. BHK

05772 **Orr, R. William; Klapper, Gilbert.** Two new conodont species from Middle-Upper Devonian boundary beds of Indiana and New York: Jour. Paleontology, v. 42, no. 4, p. 1066–1075, illus., 1968.

Two new species of platform conodonts were obtained from beds near the Middle-Upper Devonian boundary in Indiana and New York. *Palmatolepis? disparalvea* n.sp., differs from all species included within *Palmatolepis* Ulrich and Bassler by possessing a large basal cavity of unusual shape. *Polygnathus alveoliposticus*, n. sp., is distinguished by its posterior basal cavity and general lack of a free blade. The thin conodont-rich limestone at the base of the New Albany Shale (Devonian-Mississippian) of southern Indiana yielded the majority of specimens. The conodont fauna of the basal New Albany falls within the *Schmidtognathus hermanni-Polygnathus cristatus* Zone, a problematical interval between Middle and Upper Devonian.—*from* Authors' abstract

05444 **Osberg, Philip H.** Stratigraphy, structural geology, and metamorphism of the Waterville-Vassalboro area, Maine: Maine Geol. Survey Bull. 20, 64 p., illus., tables, geol. map, 1968.

In the Waterville-Vassalboro area are the Silurian Mayflower Hill and Waterville, and the Silurian or Devonian Vassalboro Formations. Bodies of biotite, granodiorite, and binary quartz monzonite intrude the sedimentary units. Folds formed in three episodes: the dominant structural element is represented by isoclinal folds with NE axial traces; a second generation, superposed on the first, are

asymmetrical and have NE–trending axial surfaces; a much younger deformation is represented by conjugate asymmetrical folds, conjugate flexures, and kink bands. Contact metamorphic aureoles are associated with the intrusive bodies in the northwestern section; to the south, it is overprinted by a younger regional (Permian) metamorphism of the Buchan type. Garnet, andalusite–staurolite, cordierite, and sillimanite isograds have been mapped in pelite.—*from* Author's abstract

05722 **Osborne, Robert H.** American Upper Ordovician Standard—[Pt.] 9, Bedrock geology of eastern Hamilton County, Ohio: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 11, pt. 1, p. 2137–2152, illus., tables, 1968.

Cincinnatian (Upper Ordovician) strata in eastern Hamilton County, Ohio, are grouped according to their respective clastic–ratio and bedding–index values. Statistical analysis of cross–bedding in 14 parairipple sets indicates that paleocurrent flow in this area was directed southwest while the sediments of the Kope and Fairview Formations accumulated. An east– or northeast–trending shoal controlled the local distribution of lithosomes, although its influence may have decreased during deposition of the Miamitown Shale. Shifting positions of benthonic invertebrate colonies, of associated shallow depressions, and of wave and slightly changing current systems account for the formation of discontinuous limestone lenses intertongued with pelitic units.—*from* Author's abstract

Ossing, Henry A. *See* Crowley, Francis A. 05733

Owens, J. S. *See* Marsden, R. W. 05412

05424 **Oxley, Marvin L.; Minihan, Edward; Ridgway, Julius M.** A study of the Jurassic sediments in portions of Mississippi and Alabama, *in* Jurassic stratigraphy of Mississippi: Mississippi Geol., Econ. and Topog. Survey Bull. 109, p. 39–77, illus., 1968.

Annual production of Jurassic oil in Mississippi jumped from 500,000 bbl in 1964 to 8,000,000 in 1967. Available electric logs and Trowbridge sample logs were examined for a regional isopachous, lithofacies, and stratigraphic report on the Smackover, Haynesville, and Cotton Valley formations in the anticipated trend, including adjacent Alabama. Information from Jurassic tests in 18 fields is supplemented by seismic–profile and gravity interpretations. Tectonic factors manifest in the subcrop pattern of sediments include extended Appalachian folds, normal faults, salt uplift, and indications of volcanism. In the "Phillips" fault zone, wells in upthrown parts pass from a thin Cotton Valley section at top directly into Paleozoic carbonates; in downthrown parts wells to Pennsylvanian strata cut all three formations.—GDC

05691 **Palframan, D. F. B.** A method of representing ammonoid suture lines: Jour. Paleontology, v. 42, no. 4, p. 1082–1084, illus., 1968.

The technique described is particularly useful for suture drawing of specimens having a diameter of about 50 mm and smaller, especially those possessing complex sutures. The specimen is affixed to a rotating mounted screw on a microscope stage micrometer, a device permitting the specimen to be moved so that the suture being drawn is kept parallel to the plane of focus. Proper reference lines for sutural ontogenies are discussed.—JP

Palmer, Harold D. *See* Moore, David G. 05237

Palonen, P. *See* Card, K. D. 05465

Palonen, P. *See* Card, K. D. 05466

Palonen, P. *See* Card, K. D. 05467

05858 **Pannella, Giorgio; MacClintock, Copeland.** Biological and environmental rhythms reflected in molluscan shell growth, *in* Paleobiological aspects of growth and development, a symposium: Paleont. Soc. Mem. 2 (Jour. Paleontology, v. 42, no. 5, supp.), p. 64–80, illus., tables, 1968.

Living specimens of the bivalve *Mercenaria mercenaria* were notched at the growing edge of the shell and planted intertidally. Shells from two lots, killed at intervals of 368 and 723 days after planting, show the same number of small growth increments as there were days from notching to killing. Superimposed on daily growth record are effects of winter and tides. The clearest tidal cycles of deposition were seen in shells of the bivalve *Tridacna squamosa*. Preliminary results of growth increment counts in fossils [Pennsylvanian to Miocene bivalves and several other mollusks] show a generally decreasing trend of the mean values of days per lunar month toward the Recent.—*from* Authors' abstract

05321 **Paransevicius, J.** Ore reserve estimation at the Pamour mine, *in* Ore reserve estimation and grade control—Canadian Centennial Conf., Quebec, 1967: Canadian Inst. Mining and Metallurgy Spec. Vol. 9, p. 209–214, illus., tables, 1968.

Mining at the Pamour mine, in the eastern Porcupine district of Ontario, began in 1936 in a wide conglomerate zone containing evenly disseminated gold values. Orebodies are classified as: wide disseminated zones, tabular high-grade veins, and tabular low-grade veins. By cutting high assays to 0.50 oz, the calculated grade was close to the mill grade. With the discovery of new orebodies and decline of grade in the conglomerate, new cutting levels had to be established. Grade of ore blocks is calculated from diamond drill intersections and muck and chip samples. Dilution due to sloughing is a major problem.—ESL

05319 **Parfitt, P. O.** Ore reserve estimation and grade control at McIntyre, *in* Ore reserve estimation and grade control—Canadian Centennial Conf., Quebec, 1967: Canadian Inst. Mining and Metallurgy Spec. Vol. 9, p. 197–202, illus., 1968.

The McIntyre mine [Ontario] consists of two distinct operations: a gold mine with numerous narrow veins, mined by cut-and-fill methods, and a copper mine in which a number of extensive zones of disseminated sulfides are mined in large, open, longhole stopes. Gold veins are irregular and values very erratic. No satisfactory mathematical analysis has been found for estimating average grade from chip samples, and an arbitrary system of cutting high assays is used to reconcile mine assays with mill grade. In the copper mine, reserves are calculated from definition diamond drilling, and ore blocks outlined on assay limits. Owing to discontinuities in veins, the as-mined grade is about 20 percent lower than the average grade of drill-hole intersections.—*from* Author's abstract

05358 **Park, Charles F., Jr.** Mineral deposits of the Pacific coastal region, *in* Ore deposits of the United States, 1933–1967 (Graton-Sales Volume), V. 2: New York, Am. Inst. Mining, Metall. and Petroleum Engineers, p. 1521–1530, illus., 1968.

Mining in the region has passed through three stages of development. First came the gold rush days, a period when gold and silver were the objects of intensive search. Second was the development of the high-grade base-metal deposits and of the smaller and more refractory precious metal deposits. Third was the modern period that covers the discovery and development of the rarer metals, of large low-grade deposits, and of the industrial and nonmetallic minerals. Brief discussions of the salient geologic features of the region and a few of the better known mineral deposits are given. The regional geology is favorable for continued exploration and discovery of new deposits and districts.—Author's abstract

Park, J. K. *See* Roy, J. L. 00049

Park, J. K. *See* Robertson, W. A. 05468

05673 **Park, Richard A.** Paleoecology of *Venericardia sensu lato* (Pelecypoda) in the Atlantic and Gulf Coastal Province—An application of paleosynecological methods: Jour. Paleontology, v. 42, no. 4, p. 955–986, illus., tables, 1968.

Study of six subgenera of *Venericardia* from the Cenozoic of the Atlantic and Gulf Coastal Province indicates that each subgenus has its own characteristic ecology and that some subgenera have undergone changes in ecology during Cenozoic time. This study was based on 198 samples which were compared on ecological bases, independent of spatial and temporal controls, by means of a morphologic analysis

of the contained microfaunas. The comparisons were effected by an ordination technique in which similarity coefficients were computed for all the assemblages, and the assemblages were positioned in a three-dimensional model which expressed their environmental relationships.—*from* Author's abstract

Parker, Harvey W. *See* Richards, Adrian F. 05206

Parker, P. L. *See* Winters, Kenneth. 00037

05546 **Parks, William S.** Geologic map of the Silerton quadrangle, Tennessee: Tennessee Div. Geology Geol. Map GM 439-SE, scale 1:24,000, separate text, 1968.

The accompanying text, "Mineral resources summary of the Silerton quadrangle," by C. R. Sykes is cited separately.—MCM

05326 **Parrish, I. S.** Grade control at the Copper Rand Mines Division, Patino Mining Corporation, *in* Ore reserve estimation and grade control—Canadian Centennial Conf., Quebec, 1967: Canadian Inst. Mining and Metallurgy Spec. Vol. 9, p. 160–167, illus., table, 1968.

At the Copper Rand mine, the ore occurs principally as 12- to 36-in veins of chalcopyrite, lying in or near dike rocks, or as disseminations and veinlets of chalcopyrite in sideritic zones up to 100 feet wide. At the Jaculet mine it occurs principally as 6-in veins and as disseminations in sideritic matrix. At the Portage mine, ore occurs as veins and stringers of pyrite and chalcopyrite in black, highly sheared, altered anorthosite and gabbro. Grade control practices at each mine vary with the geology and stoping methods; they begin with a careful study and evaluation of ore reserves and are carried through into the planning stages, where stoping methods and the deployment of services are partly dependent on geological and potential grade considerations.—*from* Author's abstract

Partheniades, Emmanuel. *See* Etter, Robert J. 05260

05463 **Patchen, Douglas G.** Oriskany Sandstone–Huntersville Chert gas production in the eastern half of West Virginia: West Virginia Geol. and Econ. Survey Circ. 9, 30 p., illus., tables, 1968.

Several significant gas discoveries in the Huntersville Chert (Middle Devonian) and Oriskany Sandstone (Lower Devonian) have been made in the last decade in eastern West Virginia. Nine new fields have been discovered since 1961, bringing to 16 the number of fields in this part of the State. Seventy gas wells have been drilled in these new fields, plus 150 in the older fields, many of which are now used for storage. Drilling activity has declined in the last two years with the exception of South Burns Chapel Field in Monongalia and Preston Counties, which is the largest of the new fields.—Author's abstract

05464 **Patchen, Douglas G.** A summary of Tuscarora Sandstone ("Clinton Sand") and pre-Silurian test wells in West Virginia: West Virginia Geol. and Econ. Survey Circ. 8, 29 p., illus., tables, 1968.

Principal targets for deeper drilling in West Virginia are the Devonian Oriskany Sandstone, Silurian Newburg sand and Tuscarora Sandstone, and several pre-Silurian formations. Gas accumulation in the Tuscarora is known in the north, west-central, and southwest where 90 wells have penetrated the Tuscarora in 32 counties; 13 of these have discovered gas in commercial quantities but gas in the western areas has a high content of inert gases and low heating values. Fifteen wells have tested pre-Silurian formations with recent testing confined largely to eastern and northern sections. Although gas shows have been recorded in several Ordovician and Cambrian formations, the Ordovician Trenton Limestone and possibly the Cambrian Conococheague Formation are considered the most potential pre-Silurian reservoirs.—*from* Author's abstract

05581 **Patchen, Douglas G.** The technique of X-ray radiography—Some applications to geology: West Virginia Acad. Sci. Proc. 1968, v. 40, p. 247–254, illus., 1968.

X-ray radiography is a relatively new technique now being applied to several facets of geologic study. This technique works on the principle of differential absorption of X-rays of various intensities by materials because of variations in their thickness, density, and composition. The Department of Geology at West Virginia University and the West Virginia Geological Survey X-ray laboratory now includes a Faxitron 804 radiographic unit being used to study: (1) the internal features of macro- and microfossils; (2) core samples from oil and gas wells to determine porosity, permeability, small-scale structures, and depositional environments; and (3) the internal features and origins of sedimentary structures. Photographic prints made from the radiographs are excellent classroom aids for students of paleontology and sedimentology. Stereoscopic pairs enable the study of these features in three dimensions.—Author's abstract

Patrick, J. L. *See* Ensign, C. O., Jr. 05311

Patrick, J. L. *See* Ensign, C. O., Jr. 05409

05187 **Patton, William W., Jr.; Hoare, Joseph M.** The Kaltag fault, west-central Alaska, *in* Geological Survey research 1968, Chap. D: U.S. Geol. Survey Prof. Paper 600-D, p. D147-D153, illus., 1968.

The Kaltag fault has been traced for 275 miles across west-central Alaska from Norton Sound to Tanana. Reconnaissance geologic mapping along the fault indicates that between 40 and 80 miles of right-lateral offset may have occurred since Cretaceous time. Study of aerial photographs along the fault reveals evidence of recent activity over nearly its entire length, and of local drainage offset of as much as 1.5 miles. The remarkably straight trend of the fault, its parallelism with known and suspected strike-slip faults of southwestern Alaska, and the evidence of major lateral dislocation suggest that the Kaltag is a major strike-slip fault.—Authors' abstract

Paul, H. *See* Naeser, C. W. 00004

Pec, K. *See* Wickens, A. J. 05455

Peck, John H. *See* Weir, Gordon W. 05189

05638 **Pecora, W. T.** Erforschung von Bodenschätzen vom Weltraum aus: Umschau, v. 68, no. 23, p. 727, 1968.

Application of various remote-sensing techniques is expanding the horizons of mineral exploration. Examples are the mapping of an area of some 800,000 sq mi in Peru and neighboring parts of Bolivia and Chile from Gemini-9 photographs and detection of tufflike rhyolites, fractures, and faults below the desert sands of central Nevada from infrared aerial photographs. The U.S. Geological Survey is already involved in plans for instrumentation and launching of a series of geologic satellites.—MS

05313 **Peebles, G. A.; Ward, D. M.** Ore reserve estimation and grade control at Eldorado's Beaverlodge operation, *in* Ore reserve estimation and grade control—Canadian Centennial Conf., Quebec, 1967: Canadian Inst. Mining and Metallurgy Spec. Vol. 9, p. 239-250, illus., tables, 1968.

Methods used in a vein-type uranium deposit [Saskatchewan] are described. A brief introduction is given of mine geology, with emphasis on nature and distribution of mineralization. Procedures followed in calculation of ore reserves are systematically described, beginning with initial outlining and blocking in of ore zones through to the final summation as prepared on IBM equipment. Various techniques and practices that mine geologists use in grade control work are described. Several different types of radiometric equipment are used for underground assaying and to facilitate determination of ore-waste contacts. Application and results obtainable from these instruments are briefly discussed. Daily mine production grades are determined from radiometric assays of muck samples taken from ore cars. Production data are tabulated and processed on IBM equipment.—*from* Authors' abstract

05343 **Pemberton, Roger.** Practical geophysics—[Pt.] 1, Radiometric exploration—Modern tools in the search for uranium: Mining in Canada, May 1968, p. 34–42, illus., tables, 1968.

In a new series on geophysics as a practical tool, a theory is outlined for the development of new spectrometers which can discriminate between radiation from different elements and measure the proportions in which they occur. Work during the first uranium 'boom' of the 1950's was hampered by the inability to weed out quickly the often preponderant radiation from K–40. Average content of the K, Th, and U in igneous and sedimentary rocks and the U and Th series are tabulated. Examples of application of modern integral and differential spectrometers to prospecting in Canada are cited. In airborne surveying, elimination of potassium sources is possible; on the ground and in the drill hole, estimates of grade and dimensions can be made readily and accurately without blasting or detailed channel sampling for assay in remote laboratories.—GDC

05681 **Perkins, R. D.; Enos, Paul.** Hurricane Betsy in the Florida–Bahama area—Geologic effects and comparison with Hurricane Donna: Jour. Geology, v. 76, no. 6, p. 710–717, illus., 1968.

Donna in 1960 and Betsy in 1965, storms of comparable size and intensity, both passed over the Florida Keys, but their geologic effects differed. Both damaged reefs, but Betsy did less damage because Donna had removed the weaker elements. Local large-scale movement of sand and supratidal sedimentation were much more extensive during Donna than Betsy. Different paths and circulation patterns for the two storms are possibly a cause of the different effects. Only Betsy passed over the Bahama area.—DRM

Perroud, P. *See* Bauer, A. 05289

05650 **Perry, Kenneth, Jr.** Representation of mineral chemical analyses in 11 dimensional space—Pt. 1, Feldspars: Lithos, v. 1, no. 3, p. 201–218, illus., tables, 1968.

In putting experimental data on a planar diagram, the mineral chemical analysis is expressed in terms of end member molecules and then plotted in terms of molecular composition. An expression of 120 feldspar analyses is examined for consequences of procedures used to compute composition and resulting graphic analysis. Assuming variations in terms of 11 oxides, normative computation introduces a large error when there are other molecules in addition to anorthite, albite, and orthoclase. Quantitative relations are compared between molecular compositions computed with the Norm and by an algebraic method. Advantages or disadvantages of a given matrix in feldspars are demonstrated in mineral examples of specific analyses. It is concluded that feldspar chemical analyses cannot be represented graphically without distortion or loss of generality.—GDC

Perry, T. G. *See* Bork, Kennard B. 05771

00048 **Peter, George; Lattimore, Robert.** Magnetic structure of the Juan de Fuca–Gorda ridge area: Jour. Geophys. Research, v. 74, no. 2, p. 586–593, illus., 1969.

A reconstruction can be made in which Juan de Fuca and Gorda ridges form a single, continuous, north-south trending feature. From this reconstruction, the present magnetic structural pattern can be derived by: (1) development of northwest-southeast oriented zones of weakness, (2) left-lateral motion along a system of northwest-southeast faults in the area of the Blanco fracture zone, (3) clockwise rotation and left-lateral motion of blocks north of the Blanco fracture zone, and (4) continued left-lateral offset along the northwest-southeast faults, in the course of which 250 km of the original ridge crest was destroyed and the individual faults were compressed into the present Blanco fracture zone. The Blanco fracture zone may have formed and the Juan de Fuca and Gorda ridges may have separated during the late Tertiary coastal orogeny.—*from* Authors' abstract

05593 **Peterson, Dean.** International programs of education and training, *in* Water for peace—Internat. Conf., Washington, D.C., 1967—V. 5, Organizing for water programs: Washington, D.C., U.S. Govt. Printing Office, p. 749–752, 1968.

There is a great need for international cooperation for education and training in water resources development, particularly for countries where problems are acute and adequate personnel is lacking. Suggested areas are: seminars, conferences, and the like for senior professionals; development of young professionals in specialized areas of practice; training of technicians and middle manpower; programs on the worker–farmer level; establishment of regional water resources centers; and regular university programs. Such organizations as UNESCO, WHO, ECAFE, SATO, and OAS, and private foundations might assist in establishing training programs. The Inter-American Center for Integral Development of Land and Water Resources (CIDIAT), developed by OAS and located in Venezuela is an example of such cooperation.—MCM

Peterson, Donald W. *See* Hammer, Donald F. 05347

05554 **Peterson, Gary L.** Flow structures in sandstone dikes: Sed. Geology, v. 2, no. 3, p. 177–190, illus., 1968.

A swarm of about 150 sandstone dikes crops out in the northwestern part of Sacramento Valley, Calif. Most are massive medium-grained sandstones and have no apparent internal structures, but some contain a variety of structures, part of which resemble common sedimentary structures. Tabular grains have a preferred orientation parallel with dike walls; sometimes this gives the dike rock a well developed cleavage. Some dikes are layered parallel to their margins, with some layers graded perpendicular to the dike walls; others have structures resembling crossbedding. On the boundaries between certain layers are structures resembling flute casts, groove casts and ripple marks. The internal structures are interpreted as flow structures produced when water-charged sediment was injected into tension cracks as they opened.—*from* Author's abstract

05606 **Peterson, James A.; Loleit, Allan J.; Spencer, Charles W.; Ullrich, Richard A.** Sedimentary history and economic geology of San Juan basin, New Mexico and Colorado, *in* Subsurface disposal in geologic basins—A study of reservoir strata: Am. Assoc. Petroleum Geologists Mem. 10, p. 186–231, illus., 1968.

The San Juan basin contains up to 15,000 feet of Cambrian to Recent sedimentary rocks; at least 10 major events in its history can be recognized. Earliest development of the area as a sedimentary basin took place in Pennsylvanian time. Sedimentary history is directly related to occurrence of economic deposits; major petroleum reserves are in Cretaceous and Pennsylvanian rocks, coal in Cretaceous, and uranium in Jurassic and Cretaceous. [Discussion of the stratigraphy is accompanied by a correlation chart, cross sections, and isopach maps]. Much of the San Juan basin is considered potentially suitable for waste disposal, with the Chaco slope probably the most favorable.—*from* Authors' abstract

05656 **Pettitt, Roland A.** Cement stabilization of volcanic materials–Closure [to paper 5149, 1967]: Am. Soc. Civil Engineers Proc., v. 94, paper 6131, Jour. Construction Div., no. CO 2, p. 248–250, table, 1968.

This additional information to paper 5149 (v. 93, no. CO 1, p. 11–25, 1967), deals with the feasibility of using tuffs as aggregates for soil–cement subgrades. The town of Los Alamos, N. Mex., is built on the Pajarito Plateau formed by 1,000 feet of tuff and pumice. Results of testing show that these can be used to produce stable soil–cement mixtures, addition of cement can lower compaction requirements, and the cement requirement can be lowered by using modified Proctor densities and Type III cement.—ESL

05634 **Péwé, Troy L.** Loess deposits of Alaska, *in* Internat. Geol. Cong., 23d, Prague, 1968, Proc., Sec. 8, Genesis and classification of sedimentary rocks: Prague, Academia, p. 297–309, illus., table, 1968.

Alaskan loess forms a blanket ranging in thickness from a few millimeters to more than 60 m that covers almost all the areas that lie below the altitude of 300 to 450 m; thick deposits are most widely distributed in central and western Alaska. The loess is massive and cliff forming, and similar in texture and color to loess in the rest of the world. It was blown from the vegetation-free bars of graded glacial rivers. Most of the loess was deposited during Illinoian and Wisconsin time, but is still being deposited in many areas. Radiocarbon dating reveals that loess was deposited in central Alaska during the last few thousands of years at the rate of 0.2 to 2.0 mm per year. Local differences in rate depend on nearness to the flood plain and the position of the topographic obstruction to silt-laden winds.—*from* Author's abstract

05503 **Phillips, Kenneth N.; VanDenburgh, A. S.** Hydrology of Crater, East, and Davis Lakes, Oregon *with a section on* Chemistry of the lakes by A. S. Van Denburgh: U.S. Geol. Survey Water-Supply Paper 1859-E, p. E1-E60, illus., tables, 1968.

In these small bodies of fresh water occupying closed basins in Holocene volcanic terranes, the annual water supply exceeds annual evaporation, and water must be lost by seepage from each. Crater Lake loses about 89 cfs, 72 percent of its annual supply; East Lake, in Newberry Crater, loses about 2.3 cfs, 44 percent of its annual supply; and Davis Lake, dammed by a lava flow, varies widely but averages about 150 cfs seepage loss, more than 90 percent of the total supply. An approximate water budget is computed for each lake. Crater Lake contains about 880 ppm of dissolved solids, much of which may be related to fumaroles and thermal-spring activity following collapse of Mt. Mazama. East Lake contains 200 ppm of dissolved solid, mostly from subsurface thermal springs. Davis Lake contains only 48 ppm, mostly silica and bicarbonate. Physical, chemical, and hydrologic characteristics are tabulated.—ESL

05481 **Philpotts, A. R.** Igneous structures and mechanism of emplacement of Mount Johnson, a Monteregian intrusion, Quebec: Canadian Jour. Earth Sci., v. 5, no. 5, p. 1131-1137, illus., 1968.

The Mount Johnson intrusion is a small vertical plug-like body consisting of a sequence of rocks that grade imperceptibly from a core of olivine essexite to a margin of pulaskite. A variety of depositional and erosional features in the well-layered rocks of this intrusion indicate that the first-formed rocks are at the margin of the intrusion and the youngest in the core. Experiments with a model in which two immiscible liquids convect in a vertical pipe suggest that the zonation from pulaskite at the margin to essexite in the core could result from the solidification of a convecting magma column in which a syenitic liquid had separated from an essexitic one and floated to the top.—*from* Author's abstract

Piché, W. T. *See* Smith, W. E. T. 05460

05200 **Pierce, William G.** The Carter Mountain landslide area, northwest Wyoming, *in* Geological Survey research 1968, Chap. D: U.S. Geol. Survey Prof. Paper 600-D, p. D235-D241, illus., 1968.

Coalesced landslides, mostly earthflows but partly slumps in their headward parts, cover an area 5 miles wide and more than 20 miles long on the flanks of Carter Mountain. Two periods of movement are indicated by topographic and stratigraphic relationships. The older landslides, which extended over most of the area, are subdued and extensively eroded. The younger landslides, about half as widespread, lie mostly within the older and cut it with sharp borders. Of the 100 ponds and lakes in the area, 95 are in the younger slides. An end moraine of Wisconsin age rests in places on an older slide. The moraine is also believed to overlie the Cody terrace, but a bench 30 feet below the terrace is glaciofluvial. The landslides probably are related to times of greater precipitation, and may be associated with glacial-pluvial periods.—Authors' abstract

Pillai, K. C. *See* Sreekumaran, C. 05345

05315 **Piloski, M. J.** Some comments on the "Application of trend analysis in the evaluation of the Whalesback mine, Newfoundland" [by F. P. Agterberg, 1968],

in Ore reserve estimation and grade control—Canadian Centennial Conf., Quebec, 1967: Canadian Inst. Mining and Metallurgy Spec. Vol. 9, p. 89–94, illus., tables, 1968.

This note discusses the suitability of trend analysis as applied at the Whalesback mine by comparing Agterberg's results (ibid., p. 77–88) with conventional calculations and trial-and-error method by which actual stoping boundaries were established before trend-surface analysis was undertaken. Trend-surface analysis gives a figure of 1.58 percent copper for a block, and calculations based on the area-of-influence method yield an average of 1.35 percent copper. Actual production performance of the block cannot be precisely defined, but there appears to be a tendency toward over-estimation when using trend-analysis techniques. The application of trend surfaces in determining mining limits at cut-off grades is discussed.—ESL

05682 **Pitty, A. F.** A simple device for the field measurement of hillslopes: Jour. Geology, v. 76, no. 6, p. 717–720, illus., 1968.

A variable-angle parallelogram of wood or metal slats allows rapid and accurate measurement of slope profiles by increments. The device is set in a series of end-to-end positions along any desired profile. It has a fixed bubble level to set the uprights vertical and an attached protractor to measure the angle of uprights to crosspieces when the latter parallel the slope. One man can quickly determine slope and distance along the profile (always crosspiece length) for each position. The device provides abundant data on microrelief as well as the whole profile.—DRM

05180 **Pluhowski, E. J.; Thomas, C. A.** A water-balance equation for the Rathdrum Prairie ground-water reservoir, near Spokane, Washington, *in* Geological Survey research 1968, Chap. D: U.S. Geol. Survey Prof. Paper 600-D, p. D75–D78, illus., table, 1968.

The highly permeable sand and gravel deposits which form the Rathdrum Prairie aquifer effectively store and transmit large quantities of ground water. From a water-balance equation for the ground-water reservoir, it is estimated that underflow from the aquifer to the Spokane Valley averages about 1,000 cubic feet per second, or about 650 million gallons a day. This water enters the Spokane River in the reach between Otis Orchards and Long Lake, Washington.—Authors' abstract

05704 **Pojeta, John, Jr.** Additional data on the Paleozoic pelecypod family Ambonychiidae: Jour. Paleontology, v. 42, no. 5, p. 1255–1257, illus., 1968.

Previously unavailable type lots of the [Ordovician–Devonian, eastern U.S.] ambonychiid species *Ambonychia alata*, *Byssopteria radiata*, and *Mytilarca wabashensis* are illustrated by photographs. A new specimen of *Allonychia flanaganensis* shows that this species is ribbed; previously its sculpture was unknown. Northrop's (1939) Silurian ambonychiid species from Gaspé [Quebec] were inadvertently overlooked in earlier work on this group (Pojeta, 1962, 1966); the ribbed ambonychiids which he discussed may all belong to *Amphicoelia*, whereas the nonribbed species probably belong to *Mytilarca*.—*from* Author's abstract

00032 **Pollack, Henry N.** Gravitational mechanism for sea-floor spreading: Science, v. 163, no. 3863, p. 176–177, illus., 1969.

The gravitational attraction of the continents produces a force field at the surface of the Earth, similar in geometry to lithospheric displacements deduced from studies of earthquake focal mechanisms.—Author's abstract

05367 **Pollack, Sidney S.** Disordered pyroxene in chondrites: Geochim. et Cosmochim Acta, v. 32, no. 11, p. 1209–1217, illus., tables, 1968.

A summary of the results on the occurrence of disordered pyroxene in chondrites is presented. Disordered orthopyroxene has been found in 5 of 15 enstatite and 20 of 51 ordinary chondrites. X-ray diffraction studies of Bamle enstatite deformed under shearing stress conditions (29–34 kbars at 500–900°C) and 150 and 450 kbars

explosive shock, Papuan clinoenstatite, and synthetic enstatites, produced by arc fusion melting, have also been made, and only synthetic crystals show disorder similar to that found in meteorites.—Author's abstract

Pollock, Charles A. *See* Orr, R. William. 05761

05221 **Potapoff, P.** Ore reserve estimation and grade control methods for nickel-copper-iron sulphide deposits at Sudbury, Ontario, *in* Ore reserve estimation and grade control—Canadian Centennial Conf., Quebec, 1967: Canadian Inst. Mining and Metallurgy Spec. Vol. 9, p. 130–138, illus., 1968.

On the Falconbridge orebodies "probable" reserves are estimated from exploration boreholes, and "proven", from underground development working; the cross-section method is used to calculate both. The polygon method is used only to calculate probable reserves in bodies with vertical boreholes. Seven orebodies described yielded a higher metal content than was shown in either type of reserve. Grade control methods of primary importance include accounting of stope costs, geologic mapping, and sampling. Computers were used successfully to calculate and compare ore reserves by cross-section methods.—*from* Author's abstract

00035 **Prewitt, C. T.; Sleight, A. W.** Garnet-like structures of high-pressure cadmium germanate and calcium germanate: Science, v. 163, no. 3865, p. 386–387, tables, 1969.

Crystals of $CdGeO_3$ grown at a pressure of 65 kb are tetragonal and have an ordered, garnet-like crystal structure with cadmium occupying the dodecahedral and octahedral sites, and germanium the octahedral and tetrahedral sites. The crystal structure ($a = 12.406 \pm 1A$, $c = 12.256 \pm 1A$, and space group $I4_1/a$) has been refined by least-squares analysis to an R (discrepancy index) of 0.073. Two high-pressure phases of $CaGeO_3$ were synthesized, one isotypic with tetragonal $CdGeO_3$ ($a = 12.514 \pm 3A$, $C = 12.358 \pm 3A$), and the other isotypic with perovskite.—Authors' abstract

Priddy, Richard R. *See* Snowden, J. O., Jr. 05668

05169 **Prill, Robert C.** Movement of moisture in the unsaturated zone in a dune area, southwestern Kansas, *in* Geological Survey research 1968, Chap. D: U.S. Geol. Survey Prof. Paper 600-D, p. D1–D9, illus., tables, 1968.

Moisture-content logs for the predominant vegetative conditions in the sand-dune area of southwestern Kansas depict the manner of moisture buildup and depletion, and illustrate conditions necessary for deep percolation. Even though the period of study included a year when precipitation was nearly the highest on record, built-up moisture under a sagebrush-grass community penetrated to a depth of only 44 feet, whereas the zone of evapotranspiration extended to at least 17 feet. Under a grass community where the zone of evapotranspiration extended to about 11 feet, a small amount of moisture (2 inches) moved as deep percolation. Under a barren area, where most of the loss by evaporation occurred in the upper 1 foot, large quantities of moisture moved as deep percolation.—Author's abstract

Privrasky, Norman C. *See* McCann, Thomas P. 05601

Procter, R. M. *See* Bamber, E. W. 05743

05317 **Purdie, J. J.** Mineral reserve calculations at Lake Dufault, *in* Ore reserve estimation and grade control—Canadian Centennial Conf., Quebec, 1967: Canadian Inst. Mining and Metallurgy Spec. Vol. 9, p. 183–192, illus., tables, 1968.

Lake Dufault Mines' West Norbeck operation is located near Noranda, Quebec. The orebody consists of a lens of massive sulfides underlain by a stockwork of chalcopyrite stringers. Ore reserves, before production, were 2,369,000 tons grading 4.0 percent copper and 7.2 percent zinc, with 2.2 oz silver and 0.03 oz gold per ton. Reserves are placed in three categories: primary, for exploration reserves; secondary, for primary developed into economic units; and tertiary, for secondary developed into production units. They are calculated mainly from diamond drill

core samples. Comparison between calculated production and mill heads has been satisfactory.—*from* Author's abstract

05608 **Pye, E. G.** (editor). Summary of field work, 1968, by the Geological Branch: Ontario Dept. Mines Misc. Paper 22, 67 p., illus., 1968.

In 1968, 30 projects were undertaken by the Geological Branch of the Ontario Department of Mines by 24 geological parties, a geochemical party, and a geophysical survey party. Locations of the areas investigated are shown on a map and results are outlined in short reports prepared by each of the project leaders. Emphasis is placed on economic aspects as an aid in selection of favorable areas for prospecting. Colored maps and final detailed reports covering most field projects are being prepared for publication.—MCM

05713 **Pyle, Thomas R.** Late Tertiary history of Gulf of Mexico based on a core from Sigsbee Knolls: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 11, pt. 1, p. 2242–2246, illus., tables, 1968.

Studies of the Foraminifera and calcareous nannoplankton in a core from the Sigsbee Knolls provide information pertinent to the history of the Gulf of Mexico basin. The sediments in this core are of late Miocene, Pliocene, and probable Pleistocene ages and are estimated to have accumulated at a rate less than 1 mm per 1,000 years. Benthonic foraminiferal depth ranges and sedimentologic criteria indicate that these sediments were deposited in deep water on a preexisting topographic high, that one of the diapiric structures known as the Sigsbee Knolls stood above the surrounding abyssal plain as long ago as the late Miocene, and that the central Gulf of Mexico has been a deep basin since at least that time.—Author's abstract

05701 **Quebec Department Natural Resources.** Catalogue of publications since 1883 [also French edition]: Quebec, Quebec Dept. Nat. Resources, looseleaf, sections paged separately, 1968.

The first part of the catalog lists publications of reports on mines, New Quebec, waters, and maps. Reports pertaining to mines have been assembled in chronological order up to 1937, and then in numerical order. The second part contains alphabetical indexes subdivided into: authors, areas, substances, and miscellany.—MCM

05401 **Radabaugh, R. E.; Merchant, J. S.; Brown, J. M.** Geology and ore deposits of the Gilman (Red Cliff, Battle Mountain) district, Eagle County, Colorado, *in* Ore deposits of the United States, 1933–1967 (Graton–Sales Volume), V. 1: New York, Am. Inst. Mining, Metall. and Petroleum Engineers, p. 641–664, illus., tables, 1968.

Paleozoic rocks intruded by a Tertiary quartz latite sill and unconformably overlying Precambrian rocks comprise the country rock. Principal ore bodies are massive sulfide replacement deposits in carbonate rocks consisting of long, pipe-like mantos in completely dolomitized Mississippian Leadville Limestone and funnel-shaped chimneys of copper-silver ore cutting across Mississippian and Devonian strata. Mineralization is continuous from chimneys into mantos, and ore bodies are roughly in the shape of a four-tined fork pointing updip. Principal minerals in mantos are marmatite and galena in a gangue of pyrite and manganosiderite; in chimneys, pyrite ore, erratic chalcopyrite, tetrahedrite, freibergite, and galena, and a shell of zinc ore. Hydrothermal alteration has affected all rocks. Structural control of ore bodies is not well defined.—*from* Authors' abstract

05639 **Ragan, Donal M.** Structural geology—An introduction to geometrical techniques: New York, John Wiley and Sons, 155 p., illus., 1968.

This book attempts to fill the need for a modern yet basic introduction to the geometrical techniques of structural geology. The contrast with the more traditional approach lies first in an emphasis on visualization and second on those techniques that yield a maximum of understanding of both old and new problems.—*from* Author's preface

05323 **Rancourt, G.; Evans, J. H.** Grade control at East Malartic Mines Limited, *in* Ore reserve estimation and grade control—Canadian Centennial Conf., Quebec, 1967: Canadian Inst. Mining and Metallurgy Spec. Vol. 9, p. 227–232, illus., 1968.

The orebodies now being mined at East Malartic [Quebec] are associated with the Sladen fault, which is subsidiary to the Cadillac–Malartic Break; ore is localized along a 3,000-ft stretch of this fault where it forms the southern boundary of the Break. Gold values, occurring in carbonatized schists, porphyries and diorites and in silicified greywacke, average between 0.13 and 0.20 oz per ton. A cheap, safe sub-level longhole mining system has been developed that produces substantial dilution from incompetent ore and host rocks, but results in more profit than could be obtained by methods designed to produce less dilution. Methods used in three main types of ground conditions are described. Control of ore drawn is maintained by car samples.—*from* Authors' abstract

05170 **Rantz, S. E.** A suggested method for estimating evapotranspiration by native phreatophytes, *in* Geological Survey research 1968, Chap. D: U.S. Geol. Survey Prof. Paper 600-D, p. D10–D12, illus., table, 1968.

A graph and table have been developed for selecting values of the coefficient *K* to be used in the Blaney–Criddle formula for estimating evapotranspiration by native phreatophytes. Values of *K* are dependent on the species of phreatophyte, the density of growth, and the depth to water table.—Author's abstract

05700 **Rasetti, Franco.** New name for the trilobite *Hawkinsia* Rasetti: Jour. Paleontology, v. 42, no. 5, p. 1313, 1968.

To replace the junior homonym preoccupied by Jeannet (1936), the name *Hawkinsaspis* Rasetti is substituted for a genus diagnosed by Rasetti (1965) for Upper Cambrian trilobites in Tennessee.—REG

05738 **Raup, David M.** Theoretical morphology of echinoid growth, *in* Paleobiological aspects of growth and development, a symposium: Paleont. Soc. Mem. 2 (Jour. Paleontology, v. 42, no. 5, supp.), p. 50–63, illus., 1968.

A model for echinoid growth is developed, from new observations of growth-line configurations, on the assumption that plate mosaic is the result of close packing. The rate of meridional growth changes regularly with distance from the apical system, and the rate of migration of plates is strongly influenced by rate of addition of new plates. A mathematical model allows the digital computer to produce ideal plate patterns; varying the constants produces many different patterns.—REG

00010 **Reed, Bruce L.; Lanphere, Marvin A.** Age and chemistry of Mesozoic and Tertiary plutonic rocks in south-central Alaska: Geol. Soc. America Bull., v. 80, no. 1, p. 23–43, illus., tables, 1969.

On the basis of potassium–argon mineral ages, plutonic rocks in the southern Alaska Range and Aleutian Range can be assigned to age groups that are Early and Middle Jurassic, Late Cretaceous and early Tertiary, and middle Tertiary in age. Most plutonic rocks south of Iliamna Lake appear to be Jurassic; north of Iliamna Lake Jurassic plutonic rocks seem restricted to the southeast side of the Alaska Range. In the western part of the Alaska Range north of Iliamna Lake, only Cretaceous and Tertiary plutonic rocks have been found. Rocks rich in K-feldspar are predominant in Cretaceous and Tertiary plutons, subordinate in Jurassic plutons. Most mineralization in the region is associated with the Cretaceous and Tertiary plutons.—*from* Authors' abstract

05703 **Reid, R. E. H.** The Carboniferous sponge *"Doryderma" dalryensis* Hinde (Class Demospongia) and the origin of heloclones and megaclones: Jour. Paleontology, v. 42, no. 5, p. 1249–1254, illus., 1968.

[The following taxonomic changes are made in preparation for revision of the Porifera section of Pt. E of the Treatise on Invertebrate Paleontology (deLaubenfels, 1955)]. A supposed Carboniferous *Doryderma, "D." dalryense* Hinde, is not a megamorine lithistid but a sublithistid sponge, with megascleres grading from

ophirhabds through heloclones to simple megaclones. Its spicules suggest the homology of heloclones and megaclones, and their origin from ophirhabds. The species is placed in *Archaeodoryderma* n.gen. and Archaeodorydermatidae n.fam. The triaene-bearing "Ophiraphiditidae" of Schrammen (1910) are referred to Cephaloraphitidae n. fam., because of the dubious character of *Ophiraphidites* Carter.—*from* Author's abstract

05709 **Reid, R. E. H.** *Hyalostelia smithii* (Young and Young) and the sponge genus *Hyalostelia* Zittel (Class Hexactinellida): Jour. Paleontology, v. 42, no. 5, p. 1243–1248, illus., 1968.

Hyalostelia smithii (Young and Young) [Lower Carboniferous, Scotland], type species of *Hyalostelia* Zittel, is redescribed from new topotype material, with discussion of the characters and relationships of the genus *Hyalostelia*. *H. smithii* is found to be a true hexactinellid, as held by Hinde (1888) and Finks (1960), not a heteractinellid as supposed by de Laubenfels (1955) [Porifera, *in* Treatise on Invertebrate Paleontology, Pt. E]. The genus is regarded as allied to *Stioderma* Finks [type species, *S. coscinum*, Permian, New Mexico], but not identical with that genus.—Author's abstract

Reinhardt, P. *See* Cohen, C. L. D. 05624

05644 **Reitan, Paul H.** Frictional heat during metamorphism—[Pt.] 2, Quantitative evaluation of concentration of heat generation in space: Lithos, v. 1, no. 3, p. 268–274, illus., tables, 1968.

Deformation of the crust varies in intensity in different parts of dynamothermally metamorphosed volumes; if it results in conversion of mechanical energy to heat within the crust, this heat production will not be uniformly distributed. Model studies examine the effects of degree of spatial concentration of this conversion on temperature rise in and near the region where heat is generated. The treatment holds constant the time duration of heat generation and total energy converted to heat, and varies antithetically thickness of crust and rate of heat production within that thickness. Resulting temperature profiles at end of a fixed period and comparison of exact data for 8 models lead to the conclusion that temperature increases of ±100°C may be possible in zones of intense deformation, 2 km or less across. Abnormally steep and 'reversed' geothermal gradients may be attributable to energy locally converted.—GDC

Renaud, A. *See* Bauer, A. 05289

05471 **Reynolds, P. H.; Russell, R. D.** Isotopic composition of lead from Balmat, New York: Canadian Jour. Earth Sci., v. 5, no. 5, p. 1239–1245, illus., tables, 1968.

Isotopic data from a gas-source mass spectrometric analysis of rock and ore leads from Balmat, show that ores were formed from lead isotopically of the type observed by Ostic et al (1967) in certain conformable deposits. Where concentration of lead in the ore is low, contamination of ore lead by lead from a rock system is apparent. The rock leads form a short-period anomalous suite derived from source material about 1,100 m.y. ago. It is clear that the primary system postulated for the rock leads is distinctly different from that of the ores; hence ore lead is not genetically related to the rock lead. The apparent existence of two primary lead systems in the Earth must be explained by any geophysical model that attempts to describe evolution of Pb-isotope ratios in general terms.—*from* Authors' abstract

05592 **Reynolds, S. E.; Yates, J. C.; Akin, P. D.** Coordinated administration of surface and ground water under the doctrine of prior appropriation [with French and Spanish summ.], *in* Water for peace—Internat. Conf., Washington, D.C., 1967—V. 5, Organizing for water programs: Washington, D.C., U.S. Govt. Printing Office, p.613–627, illus., 1968.

Surface or ground water in New Mexico is managed under the doctrine of prior appropriations. To meet needs of urban-industrial economy in the Albuquerque area and irrigation, the State Engineer in 1956, as provided by law, declared the Rio Grande to be an underground water basin in order to maintain the balance

between flows of the river and water in storage in the Santa Fe aquifer. Agreements between adjoining Colorado and Mexico involving commitments of Rio Grande water had to be considered also; withdrawals of ground water would reduce the amount in storage and also diminish the fully committed Rio Grande flows. Drilling of wells and withdrawals of ground water are permitted on condition that effects on flow are offset by retirement of valid existing rights to use of surface water.—MCM

Rhodehamel, Edward C. *See* Clark, Glenn A. 05640

05280 **Richards, A.** Shear strength of soft clay—Sess. 1, Free discussion, *in* Geotechnical conference on shear strength properties of natural soils and rocks, Oslo, 1967, Proc., V. 2: Oslo, Norwegian Geotechnical Inst., p. 131–133, illus., 1968.

Basic problems in raising of soil samples from the deep-sea floor, besides well-known sampling difficulties, are due to physical and biological changes. Expansion of water in soil during reduction of hydrostatic pressure from sea floor to surface may cause reduction in shear strength; gases evolving from a saturated sediment core under atmospheric pressure may also disrupt soil fabric, or even explode a plastic core tube in the laboratory. Growth of bacteria in the core after it is collected, which may cause degradation of in-place shear strength, is accelerated if sample is not kept at sea-floor temperature. A vane shear probe, tower-mounted for in-situ use in water depths of 300 m, is described, as well as preliminary evaluation of results of shear-strength measurements in the Gulf of Maine. An adaptation of the tower to drive a gamma-ray density probe and a piezometric probe for measuring pore pressure in-situ in soft bottom sediments were tested.—GDC

05206 **Richards, Adrian F.; Parker, Harvey W.** Surface coring for shear strength measurement, *in* Civil engineering in the oceans—ASCE Conf., San Francisco, Calif., 1967, Proc.: [New York] Am. Soc. Civil Engineers, p. 445–488, illus., tables, 1968.

Gravity and piston coring equipment and methods currently in use for obtaining quality surface samples of fine-grained soils from the ocean floor are evaluated in terms of disturbance affecting the shear strength. The methods are applicable to shallow-water sites, but since conventional drilling and sampling techniques are successful in shallow water, emphasis is placed on the recovery of samples from very deep water. Reasons for sample disturbance are cited to indicate features that should be considered in the design of samplers to minimize disturbance. Accepted standards for the design of samplers are reviewed and summarized. It is concluded that conventional marine piston samplers have undesirable features that disturb cores more than the disturbance encountered in properly designed open-barrel gravity samplers. A table summarizes the relationship between the sample quality and the method of sampling.—Authors' abstract

05181 **Richardson, Donald.** Glacier outburst floods in the Pacific Northwest, *in* Geological Survey research 1968, Chap. D: U.S. Geol. Survey Prof. Paper 600-D, p. D79–D86, illus., 1968.

Glacier outburst floods, not uncommon in the Pacific Northwest in late summer or fall, are sometimes triggered by heavy rain but may occur even during a rainless period. Associated mudflows often compound the destruction downstream. Outburst floods are particularly hazardous at Mount Rainier, Wash., where debris flows are reported to occur at a rate of one in 3–10 years. Several floods witnessed at Mount Rainier were much larger than expected from direct storm runoff or release of water temporarily impounded by landslides. Principal source of those floods is believed to have been the large volumes of water stored at times within and beneath glaciers. At present there is no known way of predicting glacier outburst floods. Conceivably, their imminence might be indicated by measurements of englacial water pressure, and their potential size by determinations of the volume of water stored in glaciers.—*from* Author's abstract

05427 **Ridge, John D.** (editor). Ore deposits of the United States, 1933–1967—The Graton-Sales volume, V. 1–2: New York, Am. Inst. Mining, Metall. and Petroleum Engineers, 1880 p., illus., tables, 1968.

Papers in these two volumes discuss deposits in eleven parts of the United States: northeastern states, southern Appalachians, central states, Lake Superior iron region, Colorado Rockies, Colorado Plateau uranium deposits, Wyoming–South Dakota uranium deposits, Utah and eastern Nevada deposits, Arizona and adjacent areas, the northwestern states, and the Pacific Coast, including Alaska. There are 80 papers in all, each of which is cited separately by author. There is also a discussion of the changes in the philosophy of classification and genesis of ore deposits which have occurred since the Lindgren classification in 1933, as well as biographies and bibliographies of L. C. Graton and R. H. Sales.—HRC

05283 **Ridge, John Drew.** Changes and developments in concepts of ore genesis—1933 to 1967, *in* Ore deposits of the United States, 1933–1967 (Graton–Sales Volume), V. 2: New York, Am. Inst. Mining, Metall. and Petroleum Engineers, p. 1713–1834, tables, 1968.

Here are summarized 162 papers, published between 1933 and 1967, that deal with various aspects of ore genesis. Emphasis is placed upon conditions to or modifications of, ore-formation theory, no matter what type of deposit is discussed. More space is given to papers on the base-metal sulfides solely because more papers are written on this subject. The final conclusion is reached that a chemically and geologically sound theory for the genesis of ore deposits can be built around the concept of concentration of ore elements in a magmatically produced ore fluid and around such surface processes as may act to concentrate economically valuable materials from rocks of any origin exposed at the surface.—Author's abstract

Ridgway, Julius M. *See* Oxley, Marvin L. 05424

00046 **Rinehart, John S.** Thermal and seismic indications of Old Faithful Geyser's inner workings: Jour. Geophys. Research, v. 74, no. 2, p. 566–573, illus., 1969.

Recent temperature measurements within Old Faithful combined with earlier seismic data provide a fairly broad knowledge of the mechanics of the geyser's action. The geyser tube, which is surprisingly deep, probably deeper than 175 m, fills suddenly shortly after an eruption. Initially the water in the whole tube superheats, but the upper 60 m soon cools as the boiling works it way downward. Finally, the hotter water below the 60-m level rises to the top fairly rapidly, again superheating the water in the upper regions, causing the eruption to start. The boiling rapidly cascades downward, thrusting water from the reservoir to continue the eruption.—Author's abstract

00047 **Rinehart, John S.; Murphy, Anabeth.** Observations on pre- and post-earthquake performance of Old Faithful Geyser: Jour. Geophys. Research, v. 74, no. 2, p. 574–575, illus., 1969.

The mean interval between eruptions of Old Faithful Geyser appears to be correlated with major earthquake activity. Two to three years before a major earthquake the interval begins to decrease uniformly and then suddenly increases at the time of the earthquake. The change in interval length is probably related to changing regional stresses that produce significant local strains.—Authors' abstract

05494 **Ringe, Louis Don.** Geomorphology of the Palouse Hills, southeastern Washington [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 29, no. 5, p. 1732B, 1968.

Ritter, John R. *See* Scott, Kevin M. 05551

05663 **Roach, R. A.; Duffell, Stanley.** The pyroxene granulites of the Mount Wright map-area, Quebec-Newfoudland [with French abs.]: Canada Geol. Survey Bull. 162, 83 p., illus., tables, 1968.

Granulite facies in the Superior province north of the Grenville front are similar to charnockitic rocks from Precambrian shields elsewhere. The geological setting in the Mt. Wright area, mode of occurrence, distinguishing features, characteristic minerals of the granulites, and petrography of various types are described. Traced southward, the rocks become progressively more crystallized by later retrograde

Grenville metamorphism, which involved mineralogical changes. Petrogenesis and P-T variables are discussed in relation to nature of the feldspars, presence of hydroxyl-bearing minerals, and fabric of the granulites. Charnokite nomenclature is considered in light of reinterpretation by Subramanian (1959); postulated origins are reviewed. A proposed nongenetic classification emphasizes chemical composition and position of these rocks within the metamorphic facies.—GDC

05569 **Roberson, H. E.; Weir, A. H.; Woods, R. D.** Morphology of particles in size-fractionated Na-montmorillonites [with French, German, and Russian abs.]: Clays and Clay Minerals, v. 16, no. 3, p. 239-247, illus., tables, 1968.

Electron microscopy of particles in four size fractions obtained by centrifugation of four samples of Na-saturated montmorillonite from Wyoming, Arizona, and Texas showed details of their morphology. The finest fraction of each consists predominantly of very thin, separate flakes, whereas all coarser fractions, 80 percent or more by weight, are composed of microaggregates. For all samples, preferred orientation is best developed in specimens formed from flakes of the finest fractions. Microaggregates are stable in dilute suspension, although they swell, but can be disrupted by ultrasonic vibration. Differences in dispersion behavior between separate flakes and microaggregates are not due to differences in interlayer charge or composition, but to interlocking of flakes in microaggregates during crystal growth, which prevents complete separation in dilute suspension.—*from* Editor's abstract

Roberts, J. L. *See* Hales, A. L. 05461

05431 **Robertson, D. K.; Cumming, G. L.** Lead- and sulfur-isotope ratios from the Great Slave Lake area, Canada: Canadian Jour. Earth Sci., v. 5, no. 5, p. 1269-1276, illus., tables, 1968.

Lead- and sulfur-isotope ratios were determined for galenas and iron sulfides from two areas around Yellowknife, N.W.T. Sulfur-isotope ratios are close to the meteoritic value or slightly positive. Lead-isotope ratios fall into two groups, one derived from a source with $Th/U = 4.3$ and $\mu = 9$-11, the other from a source with $Th/U = 3.5$ and $\mu = 9.0$. The ratios fall on an anomalous lead line, indicating an event about 4,000 m.y. ago, and another about 2,800 m.y. ago. Other sulfide samples from Great Slave Lake area, primarily outside the 2,800 m.y. province, indicate events at 2,800 m.y. and 1,550 m.y., the latter probably representing the last major tectonic event in the area. Sulfur-isotope ratios vary from +1 percent to -13 percent per mille relative to meteoritic value, suggesting remobilization of leads by thermal metamorphism and recombination with crustal sulfur enriched in S-32.—*from* Authors' abstract

05468 **Robertson, W. A.; Roy, J. L.; Park, J. K.** Magnetization of the Perry Formation of New Brunswick, and the rotation of Newfoundland: Canadian Jour. Earth Sci., v. 5, no. 5, p. 1175-1181, illus., tables, 1968.

Remanent magnetization of the Upper Devonian Perry Formation of New Brunswick consists of two components B and A acquired before and after folding (pre-Westphalian D), respectively. The stability spectra of these components overlap and it is difficult to define them accurately and calculate their errors. The best estimate of the older (B) component (with respect to bedding) is 175, +23 (pole 32°N., 118°E.) but this may be in error by 15° or more; its age is considered to be Late Devonian or Mississippian. The best estimate of the younger (A) component (with respect to present horizontal) is also 175, +23 and its age is considered to be early Pennsylvanian or older. The uncertainty in estimating directions, however, means that the paleomagnetic observations, although they do not preclude the possibility, do not provide independent evidence that Newfoundland has rotated.—*from* Authors' abstract

05591 **Robinove, Charles J.** Remote-sensing potential in basic-data acquisition [with French and Spanish abs.], *in* Water for peace—Internat. Conf., Washington, D.C., 1967—V. 4, Water supply technology: Washington, D.C., U.S. Govt. Printing Office, p. 991-1005, illus., table, 1968.

A major direction of effort in attaining objectives of modern hydrology is to use remote-sensing instruments from aircraft and spacecraft that can provide photographs, other images, and numerical data (relating to the terrain) which have a bearing on hydrologic environment and can cover large areas economically in short periods of time. Sensor data can be correlated with available point and synthesized data to describe environmental characteristics. Tabulated evaluation of remote sensors—photography (panchromatic, multispectral, infrared, color, and infrared-color), infrared radiometry, infrared imagery, and radar imagery—includes general comments on potential value and use, data available from remote-sensor systems, snow surveying and mapping, mapping and description of ground-water features, glaciology, geomorphology, etc.—MCM

05618 **Robinson, J. E.; Charlesworth, H. A. K.; Kanasewich, E. R.** Spatial filtering of structural contour maps, *in* Internat. Geol. Cong., 23d, Prague, 1968, Proc., Sec. 13, Other subjects: Prague, Academia, p. 163–173, illus., 1968.

In analyzing a structural contour map it is often necessary to focus attention on features of a specific scale in order to determine accurately their magnitude, trend and extent. This can best be done by suppressing features which have a masking effect. The map and its amplitude spectrum are analyzed to determine the desired structures and their constituent wavelengths. A filter is then designed to pass only those wavelengths that constitute the desired structural features. It is computed in the frequency domain, and its spatial equivalent determined by means of a two-dimensional Fourier transform. The map is then digitized and the spatial filter convolved with it to produce a new map displaying the desired features. A structural contour map of the sub-Cretaceous unconformity under the Interior Plains of southern Alberta is used to illustrate the process.—*from* Authors' abstract

Robinson, Paul T. *See* Swanson, Donald A. 05188

05491 **Robinson, Thomas W.** The effect of desert vegetation on the water supply of arid regions [with French and Spanish summ.], *in* Water for peace—Internat. Conf., Washington, D.C., 1967—V. 3, Water supply technology: Washington, D.C., U.S. Govt. Printing Office, p.622–633, illus., table, 1968.

Xerophytic vegetation depletes the soil-water reservoir and reduces the amount of water available for recharge to ground water. Beneficial phreatophytes in western United States are mainly grasses, the nonbeneficial, mostly woody plants; all prevent erosion. Water requirements for phreatophytes are not the same for all species and may vary from year to year and place to place for a given species. Water requirements for seven species are being measured in evapotranspiration tanks at four widely separated localities. Previous studies indicate phreatophytes deplete limited water resources of arid areas without substantial benefit to man; they also reduce discharge of springs and flow of streams during the growing season. In terms of man's needs the water used by a square mile of cottonwood would supply the needs of a city of nearly 23,500 people, and of saltcedar one of 28,300 population.—MCM

05769 **Rodriguez, Joaquin; Gutschick, Raymond C.** *Productina, Cyrtina*, and *Dielasma* (Brachiopoda) from the Lodgepole Limestone (Mississippian) of southwestern Montana: Jour. Paleontology, v. 42, no. 4, p. 1027–1032, illus., tables, 1968.

Three brachiopod species belonging to the genera *Productina* Sutton, *Cyrtina* Davidson, and *Dielasma* King are described from insoluble residues that were obtained from the Lodgepole Limestone (Kinderhookian, Early Mississippian) of southwestern Montana. Of the three described species, *Productina lodgepolensis* is new, and *Dielasma* cf. *D.? utah* (Hall and Whitfield) may also be new. All specimens are silicified and well preserved which allows study of the interior features of the valves. The range of *Dielasma* is extended to include Early Mississippian (Kinderhookian) forms.—Authors' abstract

05714 **Roehler, Henry W.** Redefinition of Tipton Shale Member of Green River Formation of Wyoming: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 11, pt. 1, p. 2249–2256, illus., 1968.

Stratigraphic studies of the Eocene Green River Formation in southwestern Wyoming indicate that more than half of the type Tipton Shale Member in the Washakie basin is composed of strata assigned to the Wilkins Peak Member in the Green River basin. To remedy the overlapping of stratigraphic names, the Tipton Shale Member is redefined, and a principal reference section is named that excludes the Wilkins Peak Member. Stratigraphic relations are described and illustrated in surface and subsurface cross sections.—Author's abstract

05511 **Romberger, Samuel Bergstresser.** Solubility of copper in aqueous sulfide solutions coexisting with covellite from 25° to 200°C, with geologic applications [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 29, no. 5, p. 1599B–1600B, 1968.

05621 **Romey, William D.** An evaluation of some 'differences' between anorthosite in massifs and in layered complexes: Lithos, v. 1, no. 3, p. 230–241, illus., tables, 1968.

Among the most commonly cited differences between anorthosite in massifs and in layered complexes are internal structures, texture, and plagioclase composition. Critical examination of these features shows a continuum of variation between the two extreme types of anorthosite. Several complexes with intermediate types of structure are discussed. Well developed cumulate textures, commonly thought to be restricted to layered complexes, are common in many massif-type anorthosite bodies. Plots of anorthite content of plagioclase from 38 anorthosite bodies including both layered and massif types show a normal distribution with an average of $An_{55.9}$ rather than the bimodal distribution usually assumed. Clear recognition of gradation between layered complexes and massif-type anorthosite bodies may help in the formulation of more satisfactory petrogenetic models for origin of the more enigmatic massif types.—Author's abstract

Romey, William D. *See* Middlemost, Eric A. K. 05647

05477 **Rondot, Jehan.** Nouvel impact météoritique fossile?—La structure semi-circulaire de Charlevoix [with English abs.]: Canadian Jour. Earth Sci., v. 5, no. 5, p. 1305–1317, illus., 1968.

The Charlevoix semicircular structure 100 km northeast of Quebec City, is 54 km in diameter, with a ring-shaped graben showing outcrops of Ordovician limestone, and an inner flat or slightly undulating surface, in the middle of which rises Mont des Eboulements. The inner part is fractured and contains shatter cones and red and green breccias with aphanitic components. The structure of the rocks in the center shows small veinlets and irregular masses of pseudotachylite, and the minerals show deformation features typical of rocks subjected to violent shock. Heterogeneous breccias and fused rocks are visible in one outcrop and in glacial erratics. A volcanic origin is suggested by its location on the margin of the St. Lawrence Valley tectonic system, but the evidence of rapidity and violence of the shock point to a meteorite origin.—*from* Author's abstract

Rosenman, M. *See* Ben-Menahem, Ari. 05452

05244 **Routhier, Pierre.** America, Europe, and geology: Geotimes, v. 13, no. 7, p. 19–20, 1968.

Awareness of the problem of information and communication seems to be widespread among the world's geologists. A first major aspect is that of choosing according to quality of information, depending upon reputation of an author and upon language difficulty. Americans, accused of literary isolation, have replied that the United States is so vast that it contains illustrations of most of the big problems in geology. In science, the establishment of relations is influenced by hereditary characteristics of the brain and previous experience. Both American and European geologists have much to be applied to each others problems. The imbalanced ratio of English citations to those in other languages is criticized. Exchange of research workers and teachers from one nation to another is being encouraged.—GDC

00049 **Roy, J. L.; Park, J. K.** Paleomagnetism of the Hopewell group, New Brunswick: Jour. Geophys. Research, v. 74, no. 2, p. 594–604, illus., tables, 1969.

Samples from 15 sites in Late Mississippian and Early Pennsylvanian red sediments in New Brunswick were subjected to thermal demagnetization. At all but two, fossil magnetization appears to be composed of two nearly opposed magnetizations. The sites fall naturally into group 1 with scattered directions and group 2 with well-grouped directions. At 5 of the 7 sites of group 2 both magnetizations were acquired before Early Pennsylvanian folding; thus fossil magnetization was acquired in the early history of the rock, partly before and partly after a field reversal. It is suggested that the magnetization is wholly or partly diagenetic in origin. Group 2 results are in close agreement with previously published results from the Maringouin formation of the Hopewell group. An apparent polar wandering (10°–15°) took place between Early Pennsylvanian and Late Pennsylvanian–Early Permian.—*from* Authors' abstract

Roy, J. L. *See* Robertson, W. A. 05468

05483 **Rubright, R. D.; Hart, Owen J.** Non-porphyry ores of the Bingham district, Utah, *in* Ore deposits of the United States, 1933–1967 (Graton-Sales Volume), V. 1: New York, Am. Inst. Mining, Metall. and Petroleum Engineers, p. 886–907, illus., tables, 1968.

Nonporphyry copper, lead, zinc, gold, and silver ore have been mined from a folded and faulted alternating series of Pennsylvanian and Permian limestone and sandstones, and from some Tertiary intrusives. The sediments were affected by varying degrees and types of metamorphism within 2,000 feet or more of the Bingham stock. The mineralized Bingham and unmineralized Last Chance stocks and numerous dikes and sills of granite and monzonite were intruded into the asymmetrical northwest-trending and plunging Bingham syncline. The bulk of the nonporphyry ore is found above the Midas thrust. The primary ores are in three types of deposits: concordant bedding fissures, crosscutting fissures, and replacement deposits. These deposits consist of both copper and lead–zinc ore bodies that contain various amounts of gold and silver. Secondary ore is of minor importance.—*from* Authors' abstract

05756 **Rudwick, M. J. S.** Some analytic methods in the study of ontogeny in fossils with accretionary skeletons, *in* Paleobiological aspects of growth and development, a symposium: Paleont. Soc. Mem. 2 (Jour. Paleontology, v. 42, no. 5, supp.), p. 35–49, illus., 1968.

Implications of accretionary growth in fossil organisms with accretionary skeletons are discussed with examples from the Brachiopoda. Descriptions of morphology should recognize the 'dynamic' character of preserved structures as embodying a sequence of previous growth stages; 'static' descriptions can result in misleading morphological characters and spurious taxonomic distinctions. Analysis of ontogeny in dynamic terms, and particularly the topological comparison of structures of varied form, can help distinguish true from false homologies, and hence evaluate the probability of inferred phyletic pathways. Such analyses can also be used to infer the morphogenetic 'rules' that governed the development of particular structures and, hence to locate major phyletic innovations and discontinuities in structure.—*from* Author's abstract

05560 **Rumer, Ralph R., Jr.; Shiau, J. C.** Salt water interface in a layered coastal aquifer: Water Resources Research, v. 4, no. 6, p. 1235–1247, illus., 1968.

The aim of this investigation was to determine shape and position of the interface between seaward flowing fresh water and underlying salt water in both isotropic and anisotropic nonhomogeneous coastal aquifers. A transformation for the nonharmonic anisotropic layer was introduced so that the governing equations and boundary conditions in the complex potential plane were satisfied. For the nonhomogeneous layers, the homogeneous mathematical models were superimposed under the same dynamical conditions. Solutions of the flow patterns and interface locations have been presented in dimensionless form. It was assumed that the aquifers were anisotropic or nonhomogeneous only in the two-dimensional sense. From earlier studies it has been shown that solutions obtained are valid for both the confined aquifer and the unconfined, when the length of salt intrusion is greater than the depth of the aquifer.—*from* Author's abstract

05540 **Russell, Ernest E.** Geologic map of the Chesterfield quadrangle, Tennessee: Tennessee Div. Geology Geol. Map GM 11-NE, scale 1:24,000, separate text, 1968.

The accompanying text, "Mineral resources summary of the Chesterfield quadrangle, Tennessee," by R. E. Hershey is cited separately.—MCM

Russell, R. D. *See* Reynolds, P. H. 05471

05495 **Rutherford, Malcolm John.** An experimental study of biotite phase equilibria [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 29, no. 5, p. 1732B, 1968.

05216 **Ruttan, G. D.** Ore estimation and grade control at Sherritt Gordon's Lynn Lake operation, *in* Ore reserve estimation and grade control—Canadian Centennial Conf., Quebec, 1967: Canadian Inst. Mining and Metallurgy Spec. Vol. 9, p. 139–143, illus., tables, 1968.

These mines, in northern Manitoba, began production in 1954 with an undiluted ore reserve of 14,055,000 tons at a grade of 1.22 percent nickel and 0.62 percent copper, contained in six orebodies occurring in two basic intrusive plugs. The reserve includes only ore proven by diamond drilling. The mining method requires detailed information on ore outlines and grade. Grade control is accomplished by core drilling. Experience has shown that the grade of ore calculated agrees closely with that of ore milled.—*from* Author's abstract

05334 **Rutter, N. W.** A method for predicting soil erosion in the Rocky Mountain Forest Reserve, Alberta: Canada Geol. Survey Paper 67-67, 32 p., illus., 1968.

A method is presented whereby a nongeologist, particularly a forest manager, can identify soil types in this glaciated area from a study of aerial photographs and field reconnaissance, and from this predict the degree of potential soil erosion if timber is removed. Infiltration rate, grain size characteristics, carbonate cement content, and binding strength of silt and clay are the important inherent properties to evaluate. On the basis of these, the least erodible soils include glacial outwash, alluvial fan and flood plain deposits, talus, and carbonate-cemented till with much gravel-size material; the most erodible soils are lake, pond, and muskeg deposits, and soil derived from underlying bedrock and till, mostly silt and clay. Important external factors are slope-angle and precipitation. The overall erosion risk in the Rocky Mountain Forest Reserve of Alberta is comparatively low.—GDC

05360 **Sainsbury, C. L.** Tin and beryllium deposits of the central York Mountains, western Seward Peninsula, Alaska, *in* Ore deposits of the United States, 1933–1967 (Graton-Sales Volume), V. 2: New York, Am. Inst. Mining, Metall. and Petroleum Engineers, p. 1555–1572, illus., tables, 1968.

Lode deposits of quartz-topaz greisens containing cassiterite, wolframite, and numerous sulfides occur throughout the area. Within the main area, nonpegmatitic beryllium deposits, consisting principally of fluorite, chrysoberyl, diaspore, tourmaline, and white mica, and others, are distributed zonally around the tin deposits and locally are transitional with them; all the deposits are replacements in carbonate rocks. Both tin and beryllium deposits are localized where dikes intrude brecciated rocks beneath thrusts and, although complex in detail, form tabular lodes that tend to lie along the thrusts. The granites contain abnormal amounts of tin and beryllium and lodes are believed to be genetically associated with these enriched granites.—*from* Author's abstract

05250 **Salas, Guillermo P.** Memorial to Carl Fries, Jr. (1910–1965): Geol. Soc. America Proc. 1966, p. 221–223, portrait, 1968.

05299 **Sammel, Edward A.** Convective flow and its effect on temperature logging in small-diameter wells: Geophysics, v. 33, no. 6, p. 1004–1011, illus., 1968.

Critical thermal gradients for the onset of convection in small-diameter wells are computed by means of an expression given by Krige (1939) and are shown graphically for water of several salinities and for glycerol. A series of field and laboratory tests in wells with diameters of 4.8 cm and 10.2 cm showed that water

columns are unstable at temperature gradients as low as 0.003°C per m. Magnitudes of thermal oscillations at higher gradients were as large as 0.49°C, and apparent sizes of convection cells ranged up to 210 cm in height in a 10.2 cm cylinder and to 48 cm in wells 4.8 cm in diameter. Comparison of temperatures in adjacent wells showed temperature differences as great as 3°C when thermal gradients were greater than the theoretical critical gradients. It is concluded that temperatures in the upper zone of deep wells may depart widely from ambient temperatures in the formations penetrated.—Author's abstract

Sandberg, Charles A. *See* Mapel, William J. 05184

05249 **Sandberg, Philip A.** A new specimen stub for stereophotography with the scanning electron microscope: Micropaleontology, v. 14, no. 4, p. 489–498, illus., 1968.

A new specimen stub for the Cambridge scanning electron microscope has been designed to allow oriented views of microfossils and to facilitate preparation of stereopairs. The design and operation of the new stub and its advantages over the normal stub are discussed.—Author's abstract

00018 **Savage, J. C.** Comments on paper by R. B. Gordon and L. A. Davis, "Velocity and attenuation of seismic waves in imperfectly elastic rock" [1968]: Jour. Geophys. Research, v. 74, no. 2, p. 726–728, illus., 1969.

Gordon and Davis (ibid., v. 73, p. 3917–3935, 1968) have presented strong experimental evidence that internal friction in rocks is essentially independent in amplitude and frequency over very broad ranges in both variables. It is suggested here that these observations are best explained by attributing the high-strain internal friction to one mechanism (Walsh, 1966) and the low-strain internal friction to another. Moreover, the low-amplitude mechanism is a linear one.—DBV

05716 **Schaeffer, Bobb.** A new actinopterygian fish from the Cretaceous of North America: Am. Mus. Novitates, no. 2344, 10 p., illus., 1968.

A new species of an actinopterygian fish, *Asarotus arcanus* is described. Although the collecting locality was not recorded, on the basis of the coccolith, foraminiferal, and regional stratigraphic evidence, the specimen came from the upper part of the Smoky Hill Member of the Niobrara Formation, probably in South Dakota or Nebraska. The specimen has been assigned to a new order, Asarotiformes, and a new family, Asarotidae. The persistence of the notochord, the absence of centra, the mostly cartilaginous braincase, the broad parasphenoid with its large tooth plate and posterior wings, the pattern of the excessively subdivided dermal skull, and the lepidosteoid squamation represent a peculiar combination of characters that do not seem to be duplicated in any other known actinopterygian.—KAF

05667 **Scharbert, Heinz G.** Microsyenitic dykes from the northern part of Ilímaussaq Peninsula, Southern Greenland [with German abs.]: Tschermaks Mineralog. u. Petrog. Mitt., 3d ser., v. 12, no. 4, p. 443–462, illus., tables, 1968.

Microsyenitic dikes are outstanding among the numerous dikes of the Gardar period of the Precambrian of southern Greenland. Many can be traced more than 15 km, and widths greater than 10 m are not uncommon. There are porphyritic and nonporphyritic varieties; alkali feldspars form the main constituents, accompanied by aegirine-augite, riebeckite, fayalitic olivine, ilmeno-magnetite, and apatite. There is no differentiation in the dikes. Undersaturated types are closely connected with the augite syenites of the main-masses which are supposed to be the original magma of the alkaline province. In places dikes are prior to the main intrusions. Saturated and slightly oversaturated dikes are thought to belong to the main quartz-syenites which are hybridization products of the augite syenite magma contaminated by later alkalic acidic magmas.—*from* Author's abstract

05363 **Schilling, John H.** The Gabbs magnesite-brucite deposit, Nye County, Nevada, *in* Ore deposits of the United States, 1933–1967 (Graton-Sales Volume), V. 2: New York, Am. Inst. Mining, Metall. and Petroleum Engineers, p. 1607–1622, illus., 1968.

The Gabbs mine, unique in size, is one of two magnesite deposits being exploited in the United States. The magnesite and brucite are in a dolomite of the Triassic Luning Formation in the over-riding plate of the Paradise thrust fault. Cretaceous granodiorite intrudes the Luning Formation near the deposits. Magnesite bodies are scattered around a prong of granodiorite extending north; the brucite is mainly in two bodies in contact with the prong. The magnesite and recrystallized dolomite are from hydrothermal replacement of the metamorphosed sedimentary dolomite, although the ore-forming fluids are thought to be related to an older granite of the area. The brucite is the result of the contact-metasomatic replacement of magnesite during the emplacement of the granodiorite stock.—*from* Author's abstract

Schloemer, R. W. *See* Whetstone, G. W. 05589

05197 **Schnepfe, Marian M.; Grimaldi, F. S.** Determination of rhodium in rocks, *in* Geological Survey research 1968, Chap. D: U.S. Geol. Survey Prof. Paper 600-D, p. D210-D213, illus., table, 1968.

The precious metals are concentrated by coprecipitation with tellurium formed by the reduction of tellurite with stannous chloride. A fraction containing rhodium and part of the iridium is isolated after separating tellurium, gold, palladium, and platinum. Rhodium is determined in this fraction spectrophotometrically with stannous bromide in a perchloric-hydrobromic acid medium. Approximately 0.01 ppm Rh can be detected as a lower limit on a 10-g sample. Detailed data are given on the behavior of other elements in the spectrophotometric method.—Authors' abstract

05174 **Schoff, Stuart L.; Moore, John E.** Sodium as a clue to direction of ground-water movement, Nevada Test Site, *in* Geological Survey research 1968, Chap. D: U.S. Geol. Survey Prof. Paper 600-D, p. D30-D33, illus., 1968.

Sodium dissolved in water generally stays in solution. It is the predominant cation in ground water in volcanic aquifers in the Nevada Test Site, but is nearly lacking in alluvial and carbonate-rock aquifers in southern Indian Spring valley south of the Nevada Test Site. The low content of sodium in the water of Indian Spring valley shows that the water has not migrated into the valley from the Nevada Test Site.—Authors' abstract

00050 **Scholz, Christopher H.** Worldwide distribution of earthquakes: Nature, v. 221, no. 5176, p. 165, 1969.

Almost all earthquakes occur in narrow bands along oceanic ridges and transform faults, along continental transcurrent faults, or in broader zones below and behind island arcs. The depth distribution is also very limited—almost all seismic energy is released in the crust, and intermediate and deep-focus earthquakes occur almost without exception in narrow planar zones dipping about 45° beneath island arcs. This remarkably nonuniform distribution implies that the occurrence of earthquakes requires very special conditions. This communication suggests that the necessary conditions for the generation of earthquakes are the presence of high differential motion and that such motion takes place in relatively silicic rock in the crust or upper mantle where a slab of lithosphere has plunged into the mantle.—DBV

05551 **Scott, Kevin M.; Ritter, John R.; Knott, James M.** Sedimentation in the Piru Creek watershed, southern California: U.S. Geol. Survey Water-Supply Paper 1798-E, p. E1-E48, illus., tables, 1968.

In the Piru Creek watershed, geologically recent tectonic activity has created a terrain where many different kinds of rocks are exposed, and landscapes of different maturity are adjacent to each other. Direct measurement was made of sediment deposited in Lake Piru, impounded behind Santa Felicia Dam near the mouth of the creek, and the probable sediment yield of the basin above Pyramid Rock, site of a proposed reservoir upstream from Lake Piru, was determined to be 225 acre-feet per year. Multiple-regression equations were calculated using records of seven nearby reservoirs. The long-term estimate of sediment yield is substantially and unexpectedly less than that of surrounding watersheds.—ESL

Scott, R. B. *See* Moores, E. M. 05263

05235 **Scott, Ronald F.** In-place measurement of the strength of ocean-floor soils by accelerometer, *in* Civil engineering in the oceans—ASCE Conf., San Francisco, Calif., 1967, Proc.: [New York] Am. Soc. Civil Engineers, p. 419–444, illus., 1968.

In 1967 Scott suggested instrumenting conventional deep-ocean sampling or coring apparatus with a single-axis accelerometer to record motion of the device during penetration into the soil. This paper describes briefly the construction of the apparatus, shows some sample records obtained, and discusses their analysis. Conclusions are that there is a considerable increase in amount of information obtained in the sampling process, soil resistance can be calculated as a function of penetration depth, comparison can be made between in-place behavior of the soil and its shearing strength as subsequently measured in the laboratory, changes in material resistance can be correlated with subsequent core analysis, and recovery ratio can be estimated. To November 1967 about 20 accelerometer records have been obtained in water up to 6,000 feet deep.—MCM

Seed, H. Bolton. *See* Idriss, I. M. 05459

05669 **Séguin, Maurice.** Discovery of direct-shipping iron ore by geophysical methods in northern Canada: Canadian Mining and Metall. Bull., v. 61, no. 676, p. 950–959, illus., tables, 1968.

In the Precambrian of northern Quebec, Schefferville (Knob Lake) iron ores have been enriched by leaching which has increased their density, altering much of the magnetite to relatively nonmagnetic and hydrous iron oxides. By a combined gravity-magnetic-seismic and/or resistivity survey, iron-formation and potential iron zones may be distinguished from the country rock. In spite of the complex assemblages of rock types, correlation between the survey results and the geology and structure of the drift-covered area could be established. A quantitative correlation of residual gravity anomaly values with specific gravity, iron content, porosity factor, orebody dimensions and values of ground magnetic intensity above a referral lithologic unit, led to discovery in 1966 of soft ore northwest of the Schefferville mining district in the central Labrador Trough.—GDC

05712 **Seiglie, George A.** Foraminiferal assemblages as indicators of high organic carbon content in sediments and of polluted waters: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 11, pt. 1, p. 2231–2241, illus., 1968.

Assemblages related to high organic carbon content in sediments are related taxonomically to assemblages in sewage outfall areas, where sediments generally have a high percentage of organic matter. Some species of genera *Buliminella, Bulimina, Fursenkoina, Florilus, Nonionella*, and probably *Uvigerina* are related to high organic carbon content in sediments. *Florilus grateloupii* and *Fursenkoina pontoni* are dominant in sewage outfall areas of the eastern Caribbean Sea. Fossil foraminiferal assemblages found by Batjes in oil-producing Miocene formations from Trinidad are similar to living assemblages in sediment with high organic carbon content. Some of these assemblages under certain conditions might be diagnostic of source rock for oil through its relation to the organic carbon in sediments, and they may be appropriate for the study of the development of oil basins.—*from* Author's abstract

Selleck, D. J. *See* Dagenais, J. E. 05309

Shaw, Alan B. *See* Clark, Mary Gilman. 05768

05379 **Shawe, Daniel R.** Geology of the Spor Mountain beryllium district, Utah, *in* Ore deposits of the United States, 1933–1967 (Graton-Sales Volume), V. 2: New York, Am. Inst. Mining, Metall. and Petroleum Engineers, p. 1148–1161, illus., tables, 1968.

Tabular beryllium deposits (as bertrandite) in water-laid rhyolite tuff at Spor Mtn. contain the world's largest known resources. The tuff underlies topaz-bearing rhyolite (Pliocene?) that contains unusually high amounts of beryllium, fluorine, and

uranium, and overlies other Miocene or Pliocene volcanic rocks, and some marine carbonate or clastic rocks. The deposits are in hydrothermally altered tuff where it contains carbonate pebbles eroded from Paleozoic rocks and where the tuff was deposited as thick layers. The beryllium mineralization probably occurred during the Basin and Range faulting and volcanism. The beryllium-bearing tuff is related to the topaz-bearing rhyolite genetically, but the details are not certain. The Be deposits are close to the major faults, and locally the Be is concentrated at the faults. The Li, however, is evenly distributed in the tuff.—*from* Author's abstract

Shea, Edward P. *See* Meyer, Charles. 05351

05276 **Shelden, Frank D.** Transgressive facies interpretation of the Niagaran, *in* The geology of Manitoulin Island—Michigan Basin Geol. Soc., Ann. Field Excursion, 1968: [Lansing, Mich., Michigan Geol. Survey] p. 50–59, illus., 1968.

Evidence is presented and discussed to support the concept of transgressive facies for the area on and around Manitoulin Island. The concept of the offshore sediments, fore-reef detrital beds, a reef core, back-reef detrital beds, lagoon beds, and littoral deposits is described. It is then proposed that the Amabel Formation is the reef core, the Fossil Hill Formation is the back-reef detrital zone, the Mindemoya and St. Edmund Formations are the lagoonal deposits, and the Wingfield and Dyer Bay Formations are the littoral-zone deposits. All migrated during the Niagaran, thus transgressing time, and subsidence landward was greater than the sedimentation rate.—HRC

Shelden, Frank D. *See* Michigan Basin Geological Society. 05266

05485 **Shepard, W. M.; Morris, H. T.; Cook, D. R.** Geology and ore deposits of the East Tintic mining district, Utah, *in* Ore deposits of the United States, 1933–1967 (Graton-Sales Volume), V. 1: New York, Am. Inst. Mining, Metall. and Petroleum Engineers, p. 941–965, illus., tables, 1968.

Gold, silver, copper, lead, and zinc have been produced from blind ore bodies in Paleozoic sedimentary rocks that are concealed beneath hydrothermally altered volcanic rocks and cut by intrusives of Eocene age. The Paleozoic rocks are folded and faulted. Ore bodies are generally in two classes: (1) massive replacement bodies rich in silver, lead, zinc, and manganese, and (2) fissure veins valuable primarily for gold, copper, and silver. Replacement ores are primarily in the Ophir Formation and the fissure veins primarily are productive only in the Tintic Quartzite. Extensive low-grade ores have been found in Devonian carbonate rocks also. Several guides to the ore are described.—*from* Authors' abstract

Sheppard, Richard A. *See* Mudge, Melville R. 05186

Shiau, J. C. *See* Rumer, Ralph R., Jr. 05560

Shindala, Adnan. *See* Denson, Keith H. 05561

05767 **Shinn, Eugene A.** Burrowing in recent lime sediments of Florida and the Bahamas: Jour. Paleontology, v. 42, no. 4, p. 879–894, illus., 1968.

Supratidal, intertidal, and subtidal crustacean burrowers produce extensive 3-ft deep open networks in muddy marine sediments which can remain open beneath overburdens exceeding 8 feet. Burrows commonly become infilled, but compaction of either filled or open burrows has not been observed. Resemblances of Recent burrow networks to ancient reef-associated *Stromatactis* and "reef-tuba" structures suggest burrows as the origin for these debated structures. "Nested-cone" structures in cross-bedded oolite of Pleistocene age were probably produced by an anemone like the Recent form *Phyllactis*. Such structures can be used to differentiate between marine- and eolian deposited sands. Grain-size analysis of extensively burrowed sediments may give little information regarding energy level of the depositional environment. Polyester plastic casts of burrow networks have aided greatly in this study.—*from* Author's abstract

05523 **Shouldice, James R.** Proposal for forming the Canadian Association of Petroleum Geologists: Bull. Canadian Petroleum Geology, v. 16, no. 3, p. 221-224, 1968.

Following a strong recommendation by five past presidents of the Alberta Society of Petroleum Geologists that a unified geological association encompassing the Alberta, Saskatchewan, and Edmonton societies, be formed, discussion with their presidents and other members resulted in the proposed by-laws for the Canadian Association of Petroleum Geologists presented here, with letters of approval from executives of the Edmonton and Saskatchewan Societies.—GDC

Siemons, W. J. *See* Bither, T. A. 05487

Simmons, George C. *See* Gair, Jacob E. 05193

Simon, Jack A. *See* Gluskoter, Harold J. 05556

Simos, John G. *See* Barnes, Marvin P. 05376

05384 **Simpson, Thomas A.; Gray, Tunstall R.** The Birmingham red ore district, Alabama, *in* Ore deposits of the United States, 1933-1967 (Graton-Sales Volume), V. 1: New York, Am. Inst. Mining, Metall. and Petroleum Engineers, p. 187-206, illus., tables, 1968.

The rocks exposed consist of about 15,000 feet of consolidated Paleozoic sedimentary rocks with a thin veneer of unconsolidated Cretaceous sediments in the Vance area. The district is characterized by a distinctively parallel and subparallel, slightly arcuate series of faults and joint systems. In view of available information, it seems reasonable to conclude that the Birmingham red ores are of sedimentary origin, modified to a small extent by diagenetic replacement after original deposition. Reserves calculated for the district are sufficient to last for many years.—*from* Authors' abstract

05420 **Sims, Samuel J.** The Grace mine magnetite deposit, Berks County, Pennsylvania, *in* Ore deposits of the United States, 1933-1967 (Graton-Sales Volume), V. 1: New York, Am. Inst. Mining, Metall. and Petroleum Engineers, p. 108-124, illus., tables, 1968.

The Grace mine magnetite ore is characteristic of the Cornwall type. The ore has replaced a Cambrian limestone lens isolated between the Triassic diabase footwall and Triassic sedimentary rock hanging wall. The body is roughly tabular in shape, dips 20° to 30° NE. and plunges about 20° N. 80° E. The ore is granular, fine grained, typically consisting of unevenly distributed magnetite in a matrix of light green to white serpentine gangue. Pyrite and chalcopyrite are common accessory minerals, and pyrrhotite occurs locally. Calcium-magnesium silicates were formed first by contact metamorphism of impure limestone; later, the silicates were altered hydrothermally to the serpentine-talc-chlorite assemblage now present. Magnetite replaced serpentine; confining pressure was 1500 bars and temperature range was 500°-675°C during ore formation.—*from* Author's abstract

05248 **Sinclair, G. Winston.** Memorial to Alice E. Wilson (1881-1964): Geol. Soc. America Proc. 1966, p. 403-406, portrait, 1968.

05632 **Sitler, Robert F.** Glacial till in oriented thin section, *in* Internat. Geol. Cong., 23d, Prague, 1968, Proc., Sec. 8, Genesis and classification of sedimentary rocks: Prague, Academia, p. 283-295, illus., 1968.

The study of glacial till by oriented thin section is shown to be a useful method to determine: (1) the detailed characteristics of mineral, rock, and fossil content, (2) the inherent textural variations of glacial till, (3) the nature of micro-weathering and its relationship to weathering in the field, (4) the nature of microfoliation, and (5) the provenance of till constituents. This technique can also be used to correlate minor ice advances and illustrate successive reworking. A study is also included showing the correlation with the above method of heavy mineral and mechanical

textural analyses. The nature of sulfide, sulfate, and carbonate minerals is also investigated.—Author's abstract

05318 **Skopos, M. J.; Lawton, M. D.** Method of calculating ore reserves at the Anglo-Rouyn property, Saskatchewan, *in* Ore reserve estimation and grade control—Canadian Centennial Conf., Quebec, 1967: Canadian Inst. Mining and Metallurgy Spec. Vol. 9, p. 193–196, illus., 1968.

The Anglo–Rouyn copper–gold deposit in northern Saskatchewan was brought into production in 1965. Surface diamond drilling had outlined a narrow, chalcopyrite-bearing ore shoot in a steeply dipping shear zone associated with metasedimentary rocks. After additional drilling had been done, values of all surface drilling intersections were correlated, and the polygonal block was used to calculate initial drill-indicated tonnage and grade. Additional information for calculating ore reserves is obtained through diamond drilling from the footwall haulages. As more information is gained during development work, blocks are defined and classed as Proven and Probable ore. This information is then transferred to simple concise work sheets so that all reserve figures are suitable for government presentation and are readily available for mine appraisal and planning.—*from* Authors' abstract

05352 **Slaughter, A. L.** The Homestake mine, *in* Ore deposits of the United States, 1933–1967 (Graton-Sales Volume), V. 2: New York, Am. Inst. Mining, Metall. and Petroleum Engineers, p. 1436–1459, illus., table, 1968.

The Homestake orebodies are pipe-like replacements of the Precambrian Homestake Formation in zones of cross folding. It is believed that dilation of the schists has increased permeability in these zones. Chloritization, in four stages, is the most widespread effect of the mineralization. Quartz, chlorite, and arsenopyrite are common in the first stage; quartz, ankerite, and phyrrhotite make up the second stage; the third stage deposited only pyrite; and the fourth stage followed intrusions of Tertiary dikes and deposited mostly pyrite and calcite. Gold accompanied all the stages, and is always the last mineral to be deposited. It is most closely associated with arsenopyrite in the first stage but can be interpreted as having been a fourth stage deposit superimposed on products of earlier stages.—*from* Author's abstract

05698 **Slaughter, Bob H.** The neglected angle in descriptive and interpretive vertebrate paleontology: Jour. Paleontology, v. 42, no. 5, p. 1311–1312; illus., 1968.

A fast and accurate method of measuring angles of features of microscopic fossil teeth [using stereoscopic camera lucida and contact goniometer] is offered which in no way endangers fragile specimens. It is hoped that this will allow angles in degrees to replace vague statements such as; "The apex is more attenuate than that of . . ." or "The re-entrant folds are more open in . . .." It is also suggested that the accurate measurement of occlusally related angles of upper and lower mammalian dentitions will be another major consideration in associating isolated upper and lower teeth.—Author's abstract

00043 **Sleep, Norman H.** Sensitivity of heat flow and gravity to the mechanism of sea-floor spreading: Jour. Geophys. Research, v. 74, no. 2, p. 542–549, illus., 1969.

Idealized mathematical models have been constructed to show that gravity, heat flow, and regional topography cannot be expected to distinguish between sea-floor spreading where new lithosphere is intruded into a narrow zone and sea-floor spreading where new lithosphere originates from a broad upwelling. A reasonable fit is obtained between observed and theoretical gravity and regional topography for the mid-Atlantic ridge. The observed inverse relation between topographic roughness and spreading rate can be explained by the proximity of isotherms to the surface at higher spreading rates. The central rift of the Gorda rise and the mid-Atlantic ridge is too large to be compensated isostatically but may be compensated by hydraulic loss in the upwelling due to viscosity.—Author's abstract

Sleight, A. W. *See* Prewitt, C. T. 00035

Sloane, R. L. *See* Guilbert, J. M. 05565

05336 **Sloss, Laurence L.** Promotion of geology: Geotimes, v. 13, no. 7, p. 9, 1968.

In the 80th year after constitution of the Geological Society of America, its Council appointed a Committee for the Promotion of the Science of Geology. Its report creates a Panel on Scientific Direction to sponsor an annual session devoted to an active field of investigation "not currently well represented in the GSA", and to cooperate with the GSA editor in soliciting papers in fields that have not commonly been published in the GSA Bulletin. The Committee places on the American Geological Institute responsibility for guiding the evolution of education in geological sciences and improving public relations.—GDC

05294 **Smith, A. L.; Carmichael, I. S. E.** Quaternary lavas from the southern Cascades, western U.S.A.: Contr. Mineralogy and Petrology, v. 19, no. 3, p. 212–238, illus., tables, 1968.

Basaltic and andesitic lava from the Cascades have been studied. They are weakly porphyritic, containing phenocrysts of plagioclase, augite, and olivine or orthopyroxene; these phases are also found in the groundmass. Titanomagnetite is a groundmass phase in most of the lavas, and a subcalcic augite is found in the groundmass in some of the basic lavas. Orthopyroxenes are present only in salic lavas and the Ca increases with increasing iron. The composition range of phenocryst and groundmass plagioclase is very similar except that phenocrysts extend to more calcic. Residual glasses in many lavas are rhyolitic. Lavas from the different craters can be distinguished from one another by chemistry and mineralogy. The most likely origin for the orogenic lavas of the Cascades is by partial melting of the upper mantle.—*from* Authors' abstract

Smith, A. Y. *See* Dyck, Willy. 05342

05611 **Smith, F. Gordon.** Fizicheskaya geokhimiya: Moscow, Izdatel'stvo Nedra, 476 p., illus., tables, 1968; originally published in English, 1963.

This is the Russian version of *Physical geochemistry*, published by Addison-Wesley Publishing Co., 1963.—MCM

05622 **Smith, Henry W.; Okazaki, Rose; Aarstad, John.** Recent volcanic ash in soils of northeastern Washington and northern Idaho: Northwest Sci., v. 42, no. 4, p. 150–160, illus., tables, 1968.

Brown Podzolic and Podzol soils have been reported in the Kaniksu National Forest and adjacent areas of Washington and Idaho. The authors consider that the A2 horizon of these soils might be only in part pedogenic, and that its thickness might be determined by local variations in retention of a modern ash blanket. Such a fallout has not been reported for this area in the literature, although accounts from Indian traditions cite an ash fall in northeastern Washington late in the 18th century. In this area a well-preserved A2 horizon has three diagnostic features: light gray to white color when dry, moderate to strong very thin platy structure, and a silt loam texture.—MST

05302 **Smith, J. Edward.** The ancestral Lake Nipissing strandline on Manitoulin Island, *in* The geology of Manitoulin Island—Michigan Basin Geol. Soc., Ann. Field Excursion, 1968: [Lansing, Mich., Michigan Geol. Survey] p. 68–70, 1968.

The Nipissing is a pronounced and well preserved strandline that can be traced with few major breaks about Manitoulin Island. For the most part, the shore is erosional in origin, consisting of a till bluff, 5 to 40 feet in height, behind a near-shore flat of bedrock, boulder pavement, or reworked till. Along the south shore, it frequently is a massive constructional sand berm in places marked by dunes. Elevations, determined in 26 places, vary from about 637 feet to 653 feet above sea level.—HRC

05596 **Smith, Stephen C.** Education in water resources—The United States, *in* Water for peace—Internat. Conf., Washington, D.C., 1967—V. 5, Organizing for water problems: Washington, D.C., U.S. Govt. Printing Office, p. 902–905, 1968.

Water Resources as a label for educational programs in U.S. universities has come within the last decade, although many major institutions have offered courses since before the turn of the century. In addition to classroom instruction, research and incorporation of adult educational and extension courses have been important functions of university programs, but only recently have curricula been integrated to provide a student with a broad base of knowledge of associated fields to enable the specialist to approach problems with some degree of generalization. One of the integrative forces in many universities during the past decade has been the organization of water resources centers.—MCM

05454 **Smith, Stewart W.; Wyss, Max.** Displacement on the San Andreas fault subsequent to the 1966 Parkfield earthquake: Seismol. Soc. America Bull., v. 58, no. 6, p. 1955–1973, illus., tables, 1968.

Immediately following the 1966 Parkfield earthquake, several types of instruments were installed in the fault zone to monitor ground motion. In the year after the earthquake a maximum of at least 20 cm of displacement occurred on a 30-km section of the San Andreas fault, which far exceeded the surficial displacement at the time of the earthquake. The rate of displacement decreased logarithmically during this period in a manner similar to that of the decrease in aftershock activity. After the initial high rate of activity, most of the displacement occurred in 4–6 day epochs of rapid creep following local aftershocks. The variation of fault displacement along the surface trace was found to be consistent with a vertical fault surface 44 km long and 14 km deep, along which a shear stress of 2.4 bars was relieved.—*from* Authors' abstract

05460 **Smith, W. E. T.; Whitham, Kenneth; Piché, W. T.** A microearthquake swarm in 1965 near Mould Bay, N.W.T., Canada: Seismol. Soc. America Bull., v. 58, no. 6, p. 1991–2011, illus., tables, 1968.

Some 2,026 microearthquakes were recorded in a 30-day period beginning March 29, 1965, at the Mould Bay seismic station and by a small aperture array a few hundred meters to the north. About 10 percent were located; their centroid lay 12.6 km from Mould Bay on an azimuth of 121° and depth of 6.8 km. The array data yielded a P-velocity of 4.33 kmps near the surface. Magnitudes ranged from -1.1 to 2.9, with a frequency-magnitude relation of log N = 2.46 (±0.01)–0.68 (±0.01) M_L. The coefficient 0.68 suggests tectonic activity. Energy partition and directions of motion are compatible with a double couple model of focal mechanism, but magma movement cannot be ruled out as there is geomagnetic evidence of abnormally high upper mantle temperatures. From 100 events in the range M_L = 0.1 to 1.6, the energy-magnitude relation is determined as log E = 10.1 (±0.3) + 1.91 (+0.03) M_L.—DBV

05668 **Snowden, J. O., Jr.; Priddy, Richard R.** Geology of Mississippi loess, *in* Loess investigations in Mississippi: Mississippi Geol., Econ. and Topog. Survey Bull. 111, p. 12–203, illus., tables, 1968.

Pleistocene loess, thickest on ridgetops east of the Mississippi Valley, thins eastward from bluffs in Mississippi. Analyses of 400 samples taken here, and a few in Louisiana, are tabulated. Field relations, texture, mineralogy, and stratigraphy suggest a glacio-fluvial-eolian origin, and a Canadian Shield source. Unweathered silt is about 2/3 detrital quartz, 1/5 carbonates, and 1/7 feldspar and clay minerals; weathering reduces feldspar content, increases clay minerals, and removes or modifies carbonates; detrital dolomite and aragonitic gastropod shells become secondary calcite concretions, and calcareous root tubules are formed. Structural stability is due to high-permeability drainage, clay-bound silt, and skeletons of vertical tubules. Several formations are correlated with Peoria, Farmdale and even older loesses in Illinois by C-14 dates and electric logs.—GDC

05385 **Snyder, Frank G.** Geology and mineral deposits, midcontinent United States, *in* Ore deposits of the United States, 1933–1967 (Graton-Sales Volume), V. 1: New York, Am. Inst. Mining, Metall. and Petroleum Engineers, p. 257–286, illus., tables, 1968.

Three major metallogenic provinces occur: the Missouri Precambrian iron ores, the Lake Superior copper ores, and the Mississippi Valley lead-zinc-barite-fluorite deposits. The iron occurs in Precambrian andesite and rhyolite host rocks, and both discordant massive bodies and replacement-type bodies, thought to be the same age as the volcanic rocks, are known. Lake Superior copper ores include two established districts, the Keweenawan and White Pine districts, and the copper-nickel deposits in the Duluth Gabbro. The lead-zinc-barite-fluorite deposits are in four major districts: Southeast Missouri, Upper Mississippi Valley, Tri-State, and Illinois-Kentucky, and in at least eight minor districts. The major features of all of the midcontinent districts can be cataloged and from these the Mississippi Valley type ore body can be defined.—*from* Author's abstract

05404 **Snyder, Frank G.; Gerdemann, Paul E.** Geology of the Southeast Missouri lead district, *in* Ore deposits of the United States, 1933-1967 (Graton-Sales Volume), V. 1: New York, Am. Inst. Mining, Metall. and Petroleum Engineers, p. 326-358, illus., tables, 1968.

Four sub-districts are present, but only the Old Lead Belt is discussed. The ore deposits are stratiform and are localized in a narrow carbonate bar and algal reef environment [Cambro-Ordovician limestones and dolomites] on the flanks of the exposed Precambrian of the St. Francois Mountains. Ore structures include pinchout zones, disconformities, ridge structures, reefs, and submarine gravity slides. Faulting prior to and during deposition "prepared" the rock; strongly fractured areas are highly mineralized. The deposits are epigenetic in character. Mineralization is believed to have occurred at the time that post-Lower Ordovician faulting took place. The mineralizing solutions are believed to have been concentrated brines from adjacent basins that moved out of the basins during tectonic activity.—*from* Authors' abstract

Sohns, H. W. *See* Tihen, S. S. 05664

05676 **Solem, Alan; Nitecki, Matthew H.** *Cyclospongia discus* Miller, 1891—A gastropod operculum, not a sponge: Jour. Paleontology, v. 42, no. 4, p. 1007-1013, illus., table, 1968.

Cyclospongia discus Miller, 1891, originally described as a species of sponge from the "Corniferous" rocks of Bunker Hill, Indiana, is based on gastropod opercula. Study of the opercular shape and growth pattern suggests that it was associated with a helicoidal, depressed helicoidal, or planorbiform spiral shell that was probably between 48 and 53 mm in adult size. *Cyclospongia* is provisionally referred to the family Oriostomatidae (Archaeogastropoda, suborder Trochina). The exact collecting site near Bunker Hill is unknown, and the stratigraphic position of *Cyclospongia* is unknown; it is probably Devonian, but may be Upper Silurian in age.—*from* Authors' abstract

05442 **Soukoreff, W. W.** Gravity survey tested at Kisbey: Oilweek, v. 19, no. 33, p. 29-32, illus., 1968.

As an aid to understanding the trapping mechanism in the Devonian discovery well in the Kisbey area of eastern Saskatchewan, and to determine the effectiveness of the gravimetric method in detection of such features, a limited experimental gravity survey was conducted. Interpreted data showed that the oil trap must be related to pre-Cretaceous time salt solution. Of the four gravity anomalies detected, two appear to have a very shallow origin, and two appear to be considerably deeper. The gravimetric method is not able to detect areas of salt solution that may have occurred during Cretaceous times. It is possible that the discovery well is located immediately south of one of the deep anomalies. A seismic survey, now underway, and additional drilling will permit comparison of the gravimetric and seismic techniques in exploration for similar hydrocarbon accumulations.—MCM

Southard, A. R. *See* Klages, M. G. 05262

05746 **Spangler, Daniel P.; Libby, Fred J.** Application of the gravity survey method to watershed hydrology: Ground Water, v. 6, no. 6, p. 21-26, illus., table, 1968.

Results are reported of a gravity survey covering 250 sq mi and including the Walnut Gulch experimental watershed at Tombstone, Ariz. Geology of the watershed is typical of the Basin and Range province, containing deep basin-fill deposits storing a large volume of ground water, and surrounded by igneous and sedimentary rocks. Concealed border faults may have a decided effect on the hydrology. The 16 mgal gravity low over the east-central part of the watershed is interpreted as indicating about 3,200 feet of low density alluvium. Highs are associated with mountain ranges and igneous plugs. A Bouguer gravity map showing generalized geology is included.—ESL

Spencer, Charles W. *See* Peterson, James A. 05606

05558 **Spieker, Andrew M.** Ground-water hydrology and geology of the lower Great Miami River Valley, Ohio: U.S. Geol. Survey Prof. Paper 605-A, p. A1-A37, illus., tables, 1968.

The lower Great Miami River valley is one of the most productive sources of ground water in midwestern U.S. A major buried valley, formed during interglacial intervals of the Pleistocene and subsequently filled with highly permeable sand and gravel outwash, follows essentially the course of the present river. Most favorable areas for development of large supplies are in those environments where 150 feet or more of sand and gravel with no clay layers are close enough to a major stream to permit recharge by induced infiltration; yields could be up to 3,000 gpm. In other areas, yields could reach 1,000 gpm, except where tributary buried valleys are filled with clay and in upland areas where shale bedrock is overlain by relatively impermeable glacial till. Ground-water resources of much of the region are untapped. Water is generally hard.—*from* Author's abstract

Sprague, D. *See* Hart, R. C. 05330

05345 **Sreekumaran, C.; Pillai, K. C.; Folsom, T. R.** The concentrations of lithium, potassium, rubidium and cesium in some western American rivers and marine sediments: Geochim. et Cosmochim. Acta, v. 32, no. 11, p. 1229-1234, tables, 1968.

Lithium, potassium, rubidium and cesium in river water, suspended matter, and bottom sediments have been measured by a flame photometric method in samples from three western American river systems. Concentrations in four marine sediments are given for comparison.—Authors' abstract

05268 **Starkey, John.** The geometry of kink bands in crystals—A simple model: Contr. Mineralogy and Petrology, v. 19, no. 2, p. 133-141, illus., 1968.

A crystallographic explanation for the geometry of kink bands in crystals is proposed and three possible types of kinking are discussed: simple kinking, kinking associated with a phase change, and kinking associated with twin formation. The angular relationships at kink band boundaries have been calculated for a number of minerals and the results compared with observations in the literature. It is proposed that the crystallography of a mineral may be the dominant control of kink band geometry rather than external stress conditions as is generally assumed. This is probably particularly true of kink bands formed under natural conditions.—Author's abstract

05264 **Stauder, William.** Tensional character of earthquake foci beneath the Aleutian trench with relation to sea-floor spreading: Jour. Geophys. Research, v. 73, no. 24, p. 7693-7701, illus., table, 1968.

The relationship between sea-floor spreading and earthquake features noted in previous studies has been investigated further for 66 earthquakes in 1957-66. The hypocenters of these shocks fall into two groups spatially: 12 occurred along a narrow line immediately below the axis of or under the seaward slope of the Aleutian trench, while the rest were distributed over a broader tabular region beginning midway between the trench and the islands and extending under the islands. Focuses of the first group are extensional, with tension axes alined normal to the local axis of the trench; those of the second group are conformable to an underthrust of the island arc, with directions in agreement with a rotation of the oceanic plate about

a pole at 85°W, 50°N. All features could be predicted by the sea-floor spreading hypothesis.—DBV

Stead, Frederick L. *See* McCann, Thomas P. 05601

Stearn, Colin W. *See* Clark, Thomas H. 05732

05860 **Steenland, Nelson C.** Structural significance and analysis of Mid-Continent gravity high—Discussion [of paper by R. L. Coons and others, 1967]: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 11, pt. 1, p. 2263–2264, illus., 1968.

The regional gravity analysis established by Coons and others (ibid., v. 51, no. 12, p. 2381–2399, 1967) synthetically by a power-series method does not necessarily incorporate the factor of matching the observed field at all. The power series with which the gravity is analyzed more closely fits a field as higher and higher order surfaces are involved. In other words, a power series gives an input for a good contouring program, but it cannot be employed to derive true residuals.—VSN

Stephens, Edward C. *See* Coats, Robert R. 05375

Stern, T. W. *See* Lee, Donald E. 05195

05398 **Steven, Thomas A.** Ore deposits in the central San Juan Mountains, Colorado, *in* Ore deposits of the United States, 1933–1967 (Graton-Sales Volume), V. 1: New York, Am. Inst. Mining, Metall. and Petroleum Engineers, p. 706–713, illus., table, 1968.

Most mineralized areas in the central San Juan Mountains, Colorado, are associated with the youngest subsidence structures in a large volcanic cauldron complex that formed concurrently with eruption of the surrounding ash-flow field. Two local types have been recognized: (1) fissure-vein deposits along faults characterized by relatively late movement, and (2) hydrothermally altered and mineralized areas associated with postsubsidence Fisher Quartz Latite centers. The first type has provided the most production in the past; the potential of the second type has yet to be adequately tested.—Author's abstract

Stevens, R. D. *See* Wanless, R. K. 05265

05548 **Stevenson, D. R.** Geological and ground water investigations in the Marmot Creek experimental basin of southwestern Alberta, Canada [abs.]: Bull. Canadian Petroleum Geology, v. 16, no. 3, p. 414–415, 1968.

05271 **Stiegler, Jim; Gray, Fenton.** Micromorphological soil study in the Boggy Formation: Oklahoma Acad. Sci. Proc. 1966, v. 47, p. 205–210, illus., tables, 1968.

Soil was sampled from a upland flat profile on the Eastern Pasture Research Station at Muskogee, Okla. The Boggy Formation here is very silty, micaceous, and highly cemented with iron oxides; thin sections were examined. The soils have retained the silty nature of the underlying rock and are very low in clays and the horizons are high in sesquioxides, especially iron, in concretions. The B horizons have clay accumulations originating from transformation of minerals in place and from transfer from A horizon. The B3t and C horizon is the least weathered and most like the parent rock; it contains some unweathered siltstone fragments and some clay accumulation.—HRC

Still, Arthur R. *See* Gilmour, Paul. 05429

05653 **Stockwell, C. H.; Brown, I. C.; Barnes, F. Q.; Wright, G. M.** Geology, Christie Bay, District of Mackenzie: Canada Geol. Survey Map 1122A, scale 1:253,440, text, 1968.

Precambrain rocks in Christie Bay area of Great Slave Lake are: volcanic rocks and sediments of Yellowknife Group; Wilson Island Group, not in contact with typical Yellowknife Group, but older than surrounding Proterozoic rocks; Great Slave Group, deposited on an erosion surface developed on granitic rocks

and upturned edges of older sedimentary and volcanic rocks, and forming an asymmetrical synclinorium, 150 mi long, occupying almost the entire lake basin; Union Island Group, of unknown relation to the Great Slave, except that both were deposited after erosion of older granitic rocks and before deposition of the Et-Then Group. Diabase dikes and sills cut all other consolidated rocks and large faults. Rocks of the Yellowknife elsewhere contain gold-bearing and base-metal deposits, veins of quartz occur in the Great Slave, and possibilities of other resources are considerable.—MCM

05654 **Stockwell, C. H.; Henderson, J. F.; Brown, I. C.; Wright, G. M.; Barnes, F. Q.** Geology, Reliance, District of Mackenzie: Canada Geol. Survey Map 1123A, scale 1:253,440, text, 1968.

Thick morainal deposits, boulders, gravel, and sand cover much of the bedrock in the southeast quarter of the Reliance area. Precambrian rocks are the Yellowknife group, a widespread group of gneisses gradational into the Yellowknife (and Nonacho) and into granitic rocks, Great Slave Group, and Et-Then Group (Murky Formation). Diabase dikes and sills cut all other consolidated rocks and large faults. Steeply dipping dikes in the lower rocks surrounding the basin are not as large as the massive sills and dikes found within the basin. Sills up to several hundred feet thick occur on the Douglas and Kahochella Peninsulas. Quartz veins are abundant in Yellowknife sedimentary rocks on the north shore of McLeod Bay and near Nonacho Lake; most common sulfides are pyrite, chalcopyrite, and galena. Granodiorite bodies appear to afford favorable prospecting ground for radioactive minerals.—MCM

05439 **Stolte, W. J.; Campbell, T. H.** A discussion of streamflow simulation techniques as tools in wise water-resources development, with suggestions for future research: Trend Eng., v. 20, no. 4, p. 3–6, 24, illus., 1968.

In river-basin analysis, a lack of knowledge of the pertinent physical laws involved often forces the hydrologist into utilizing statistical tools. Two current complementary statistical models [multi-lag and multiple regression] are described and their properties, interrelatedness, and limitations discussed. Possibilities of using related physical watershed characteristics in the determination of statistical parameters are explored. Some current research is noted and possible future research is tentatively sketched.—Authors' abstract

05652 **Stuessy, Tod F.; Irving, Robert S.** A morphological fossil plant species, *Euonymus glanduliferus*: Southwestern Naturalist, v. 13, no. 3, p. 353–357, illus., 1968.

Rarely is the biological range of variation determinable in a fossil species, but such is the case in *Euonymus glanduliferus* Ball, 1931, which thus constitutes a morphological (as opposed to typological) species. This angiosperm leaf was described by O. M. Ball from the Eocene Wilcox Group of Bastrop County, Tex., and differs from *E. splendens* Berry, 1916, in possessing glandlike protuberances in the axils of the major lateral leaf veins. Stuessy and Irving have uncovered over 100 specimens, again from the Wilcox (Rockdale Formation) of Bastrop County; all specimens appear to be within the range of variability of a single species as to vein pattern, margins, and petiole length, but without the unifying "gland" marker some of these specimens might have been placed in different species or even separate genera.—VMJ

05643 **Sturgeon, Myron T.; Hoare, Richard D.** Pennsylvanian brachiopods of Ohio: Ohio Div. Geol. Survey Bull. 63, 95 p., illus., tables, 1968.

Brachiopods of 86 species and varieties (10 n.spp. and 3 n.var.) are described and figured from the 22 marine units of the Pennsylvanian (Pottsville, Allegheny, lower Conemaugh Groups) in an 11,000 sq mi belt in eastern Ohio. Stratigraphic distribution of each form is shown; separation of marine units by relatively thick nonmarine units in Ohio allows a more distinct zonation, especially of chonetids, productids, and spiriferids, than in most other parts of the continent. Fusulinid zones in the Appalachian basin are correlated with zones in the Eastern Interior and Western Interior basins, and with distribution of the more significant Ohio

brachiopods. The 346 collecting localities that yielded the 30,000 specimens on which this study is based are fully indexed in the appendix.—VMJ

00013 **Suppe, John.** Times of metamorphism in the Franciscan terrain of the northern Coast Ranges, California: Geol. Soc. America Bull., v. 80, no. 1, p. 135–142, illus., tables, 1969.

Field relations, K–Ar dates, and metamorphosed fossils define two periods of high-pressure, low-temperature metamorphism in the Leech Lake Mtn.–Black Butte region of northern California. For the older metamorphism, coarse white mica from glaucophane–lawsonite metabasalts yields K–Ar dates of 150 m.y., older than the time of deposition of Tithonian through Valanginian *Buchia* fossils found in this region. The fossiliferous rocks have been metamorphosed to the lawsonite-albite–chlorite–aragonite metagraywacke facies and yield K–Ar whole-rock dates from 127 to 140 m.y. The age of the younger metamorphism is thus fixed by fossils and K–Ar dates to a short period of time in the Lower Cretaceous. In addition, there are still-younger periods of sedimentation, metamorphism, and deformation in the Franciscan terrain.—*from* Author's abstract

Surface, Vaughn E. *See* Wallace, Stewart R. 05400

05690 **Swain, F. M.** Ostracoda from the Gulf of California—Additions and corrections [to 1967 paper], and availability of IBM data cards: Jour. Paleontology, v. 42, no. 4, p. 1090, 1968.

Changes in the distribution maps and lists, as well as several other corrections, are enumerated for "Ostracoda from the Gulf of California" (Geol. Soc. America Mem. 101, 139 p., 1967). The following two sets of IBM (No. 733727, General Purpose, 20 field) cards have been prepared for this assemblage: (1) taxonomic cards which also give shell measurements; (2) ecologic cards which give location, depth, and bottom type. The cards or data sheets from them may be loaned to interested micropaleontologists.—RCD

05227 **Swanson, C. O.; Irvine, W. T.** Ore estimation in Cominco mines, *in* Ore reserve estimation and grade control—Canadian Centennial Conf., Quebec, 1967: Canadian Inst. Mining and Metallurgy Spec. Vol. 9, p. 69–70, 1968.

Samples from an orebody should ideally be random and unbiased so that statistical methods can be used to determine reliability of the reserve estimate; since this is seldom possible, examples of other methods are given. At the H. B. mine [British Columbia] the orebody was resampled within the assay boundary determined by previous sampling, and results agreed with previous results. At Pine Point, the first calculation of reserves is based on pattern drilling, but it was important that assays along boundary lines, lower than cut-off grade, be included. At the Con mine, development assays for gold are cut empirically to bring reserve estimates in line with mill heads. Each type of sample requires a different degree of cutting. At the Sullivan mine, the specific gravity of each sample interval in drill core has to be taken into account.—*from* Authors' abstract

05188 **Swanson, Donald A.; Robinson, Paul T.** Base of the John Day Formation in and near the Horse Heaven mining district, north-central Oregon, *in* Geological Survey research 1968, Chap. D: U.S. Geol. Survey Prof. Paper 600-D, p. D154–D161, illus., tables, 1968.

The porphyritic welded tuff that forms the base of the John Day Formation near Grizzly to east of Clarno has been found in the Horse Heaven mining district unconformably overlying rocks thought to be in the John Day Formation. This tuff is widespread and easily recognized, represents a nearly instantaneous time interval, and initiated a lengthy period of silicic volcanism. Hence, it is logically taken as the base of the John Day in the Horse Heaven district as elsewhere. Rocks beneath the tuff and above a saprolite-mantled unconformity, once considered to mark the top of the Clarno Formation in this district are tentatively reassigned to the Clarno. A K–Ar age of 41.0±1.2 m.y. (late Eocene) for a rhyolite flow above the saprolite-mantled unconformity supports its assignment to the Clarno Formation.—*from* Authors' abstract

05220 **Swanson, E. A.** Ore reserve estimation and grade control at Buchans, *in* Ore reserve estimation and grade control—Canadian Centennial Conf., Quebec, 1967: Canadian Inst. Mining and Metallurgy Spec. Vol. 9, p. 119–122, illus., table, 1968.

The Buchans orebodies [Newfoundland] consisting of five Breccia Zone, or high-grade bodies, and two Footwall, or low-grade bodies, have produced 14,254,000 tons of ore grading 1.40 percent copper, 7.79 percent lead, 15.18 percent zinc, 6.38 percent iron, and 26 percent $BaSO_4$, with .047 oz gold and 3.64 oz silver per ton. Breccia Zone bodies are mainly massive sulfides with sharp contacts, making reserve estimation and grade control easy; 85 percent of the total ore reserve can be controlled visually. Boundaries of Footwall bodies are determined by assays. Reserve calculations are made from sections normal to the strike at 50-ft intervals and based on diamond drilling.—*from* Author's abstract

05539 **Sykes, C. Ronald.** Mineral resources summary of the Silerton quadrangle, Tennessee: Nashville, Tenn., Tennessee Div. Geology, 15 p., tables, 1968.

The only mined mineral resource in the Silerton quadrangle is sand in the Claiborne Formation and in fluvial deposits; all but one of the 20 pits are in the Claiborne, which contains sand most suitable for local road construction and maintenance. Clay has been prospected in the Porters Creek Clay and the Wilcox Formation, but none has been exploited. One oil and gas test well has been drilled. This text accompanies Tennessee Div. Geology Geol. Map GM 439-SE by W. S. Parks (cited separately).—MCM

Tappan, Helen. *See* Loeblich, Alfred R., 3d. 05666

Taylor, Beryl E. *See* Frick, Childs. 05717

05501 **Taylor, Charles Mosser.** Mineralogical applications of the electron beam microprobe in the study of a gold-silver deposit, Knob Hill mine, Republic, Washington [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 29, no. 5, p. 1777B–1778B, 1968.

Taylor, G. C. *See* Bamber, E. W. 05743

05353 **Taylor, Hugh P., Jr.** The oxygen isotope geochemistry of igneous rocks: Contr. Mineralogy and Petrology, v. 19, no. 1, p. 1–71, illus., tables, 1968.

Oxygen isotope analyses have been obtained for 443 igneous rock and mineral samples around the world. Basalts, gabbros, syenites, and andesites are uniform in O-18/O-16, with δ values of 5.5–7.0 per mil. Rhyolite obsidians from oceanic areas and Pacific U.S. coast in this range, cannot represent melted sialic crust. Others with higher δ values have a possible melted sial source. A correlation exists between O-18/O-16 ratios of SiO_2-rich differentiates and chemical trends in volcanic complexes; high O-18/O-16 ratios accompany trends with lower Fe/Mg ratios. Hydrated obsidians and perlites have δO-18 values different from primary, magmatic values. Later differentiates of the Muskox intrusion are O-18 rich, due to deuteric exchange between feldspars and an oxygen-bearing fluid.—*from* Author's abstract

05538 **Taylor, Landon C.; Wilson, Charles W., Jr.** Mineral resources summary of the Livingston quadrangle, Tennessee: Nashville, Tenn., Tennessee Div. Geology, 17 p., tables, 1968.

Mined mineral resources in the Livingston quadrangle are limestone mainly from the Monteagle, St. Louis, and Bangor Limestones, and sandstone from the Hartselle Formation. An occurrence of lead has been reported from one locality. Of the 24 wells drilled for oil and gas, five produced gas for local use. This text accompanies Tennessee Div. Geology Geol. Map GM 330-NE by C. W. Wilson, Jr. (cited separately).—MCM

05496 **Taylor, Lawrence A.** The system Ag-Fe-S—Phase equilibria and geologic applications [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 29, no. 5, p. 1733B, 1968.

Taylor, R. *See* Dagenais, J. E. 05309

05497 **Terry, Judith Shoemaker.** Taxonomy and distribution in space and time of the marine gastropod genera *Argobuccinum*, *Fusitriton*, and *Priene* (family Cymatiidae) [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 29, no. 5, p. 1733B, 1968.

Tessman, Norm. *See* Webb, S. David. 05212

05631 **Textoris, Daniel A.** Petrology of supratidal, intertidal, and shallow subtidal carbonates, Black River Group, Middle Ordovician, New York, U.S.A., *in* Internat. Geol. Cong., 23d, Prague, 1968, Proc., Sec. 8, Genesis and classification of sedimentary rocks: Prague, Academia, p. 227–248, illus., tables, 1968.

Three major, low energy, micrite-rich paleoenvironments are recognized in the Black River Group of New York. The supratidal environment is characterized by dolomitized micrite, terrigenous clastics, ostracodes, swirled burrows, desiccation cracks and birdseyes, and some blue-green algal mat laminae. These are located mainly in the Pamelia Formation. The lower half of the Lowville Formation is most representative of the intertidal environment which is typified by pelmicrite, intramicrite, vertical burrows, ripple marks, desiccation cracks and birdseyes, less dolomite, and more fossils. The shallow subtidal environment is best recognized by the abundance of nonreef biolithites, biopelmicrite, and some oolitic intrasparite and chert. Most of these are found in the lower part of the Pamelia Formation, the upper half of the Lowville Formation and the entire Chaumont Formation.—KAF

05734 **Theobald, P. K., Jr.; Thompson, C. E.** Platinum and associated elements at the New Rambler mine and vicinity, Albany and Carbon Counties, Wyoming: U.S. Geol. Survey Circ. 607, 14 p., illus., tables, 1968.

In the Medicine Bow Mts., platinum-group metals are commonly associated with copper, silver, or gold in shear zones that cut a series of mafic igneous and metamorphic rocks. At the New Rambler mine, about 50,000 tons of mine and mill waste contain an average of 0.3 percent copper, 7 ppm silver, 1 ppm platinum plus palladium, and 0.7 ppm gold. Soil samples exhibit a wide range of content of several elements; most variation can be attributed to contamination from mine workings. Stream sediments, if preconcentrated for analysis, reveal anomalies in the stream below the mine, in adjacent drainage, and on Dave Creek. Sampling of bedrock exposures provides information on the large size and provincial nature of the platinum-rich area. A properly integrated program has possibilities of locating a complex orebody.—*from* Authors' abstract

Thomas, C. A. *See* Pluhowski, E. J. 05180

05580 **Thomas, Lloyd R.; Donaldson, Alan C.** Stratigraphy of the Greenbrier Limestone of southwestern West Virginia [abs.]: West Virginia Acad. Sci. Proc. 1968, v. 40, p. 246, 1968.

05721 **Thomas, William A.** Contemporaneous normal faults on flanks of Birmingham anticlinorium, central Alabama: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 11, pt. 1, p. 2123–2136, illus., table, 1968.

Contemporaneous normal faults in Late Mississippian sandstone are approximately parallel with structural strike and are downthrown in the direction of dip. Dip of the faults decreases from 70° to 40° with depth. Throw of the faults decreases upward from a maximum of less than 60 feet. Part of the sequence is thicker on the downthrown block of each fault than on the upthrown block, and the faults are buried beneath younger, unfaulted beds. Faulting was initiated by downdip mass flow of hydroplastic clay and unconsolidated sand on an unstable initial slope. Normal gravity-slide faulting at the updip edge of the moving mass produced an irregular surface that permitted accumulation of greater thickness of sand in the depressed blocks.—*from* Author's abstract

Thompson, C. E. *See* Theobald, P. K., Jr. 05734

05695 **Thurmond, John T.** A new polycotylid plesiosaur from the Lake Waco Formation (Cenomanian) of Texas: Jour. Paleontology, v. 42, no. 5, p. 1289–1296, illus., 1968.

A nearly complete skeleton of a polycotylid plesiosaur from the Lake Waco Formation [west of Waco, McLennan County] Texas is described and figured as *Ceraunosaurus brownorum* gen. et. sp. nov. This form differs in details of the skull and limb girdles from other described polycotylids. It shows affinities to *Dolichorhynchops* and *Leptocleidus*.—Author's abstract

05664 **Tiben, S. S.; Carpenter, H. C.; Sohns, H. W.** Thermal conductivity and thermal diffusivity of Green River oil shale, *in* Thermal conductivity, 7th Conf., Gaithersburg, Md., 1967, Proc.: U.S. Natl. Bur. Standards Spec. Pub. 302, p. 529–535, illus., tables, 1968.

Thermal conductivities were experimentally determined on several different grades of raw shale and on their respective retorted shales and burned shales. Determinations were made with the heat source both perpendicular and parallel to the bedding planes, and at several different temperatures. Conductivity values for 58.6 and 8.6 gallon-per-ton shales ranged from about 0.69 W m^{-1} deg^{-1} to about 1.6 W m^{-1} deg^{-1}, respectively. Conductivities of retorted or spent shales ranged from 0.26–1.4 W m^{-1} deg^{-1}, and of burned shales from less than 0.17 to about 1.2 W m^{-1} deg^{-1}. An equation was developed for calculating thermal conductivity of the three types of shale. Thermal diffusivities, determined experimentally on 123 different grades of raw shale assaying from 8.1–59.1 gallons of oil per ton and on retorted and burned shales from these, are given.—*from* Authors' conclusions

Tilling, Robert I. *See* Greenland, L. Paul. 05293

Toewe, E. Clayton. *See* Conley, James F. 05572

05594 **Torpey, W. G.** Continuing education for scientists and engineers in water work [with French and Spanish summ.], *in* Water for peace—Internat. Conf., Washington, D.C., 1967—V. 5, Organizing for water problems: Washington, D.C., U.S. Govt. Printing Office, p. 837–847, 1968.

Recruitment of scientific and engineering personnel for water work is a basic issue confronting governments; of equal importance is the problem of keeping such personnel up-to-date, scientifically and technically. Continuing education programs involve cooperation between individuals, organizations, and government. For the individual, technical reading, university courses, in-plant courses, attendance at technical society meetings, and teaching offer the most effective means. Employers can provide educational opportunities, educational institutions can offer refresher as well as degree courses, technical societies could conduct surveys in addition to other activities, and government could encourage in-service training.—MCM

05303 **Tovell, Walter M.** The entrance to Georgian Bay (the drowned portion of the Niagara escarpment), *in* The geology of Manitoulin Island—Michigan Basin Geol. Soc., Ann. Field Excursion, 1968: [Lansing, Mich., Michigan Geol. Survey] p. 71–76, illus., 1968.

Detailed sublacustrine investigations were made by SCUBA diving and sampling to determine which of several possible origins for the feature was the more plausible. Solid rock, primarily Ordovician and Silurian limestone, forms the bulk of the subaqueous area; potholes, pitting, a little till, and ripple marks in the thin veneer of sediments, are present. Two channels appear to cross the barrier, the Yeo–James gorge and the Flowerpot–Bear's Rump channels. It is believed, however, that the general nature of the whole area and the presently known details of the bottom topography, suggest that an east–west flowing stream cut the gorge (following Grabau's [1913] suggestion of an antecedent stream) rather than a west–east flowing stream during glacial times, as suggested by Spencer (1891).—HRC

Trammell, J. W. *See* Ensign, C. O., Jr. 05409

05456 **Trembly, Lynn D.; Berg, Joseph W., Jr.** Seismic source characteristics from explosion-generated P waves: Seismol. Soc. America Bull., v. 58, no. 6, p. 1833-1848, illus., tables, 1968.

Signals from nuclear explosions were used to calibrate seismograph stations by determining the transfer functions of lumped source-propagation path-receiver systems. Other recorded signals were used to derive characteristics of the sources. It was found that source functions could be derived from distant signals when frequencies of output signals were reliably related to source. For output data used here, the low-frequency cutoff was 0.2 hz at all stations and the high-frequency cutoffs were 4.0, 3.0, 2.0 hz at near-regional, regional, and teleseismic distances, respectively. The low-frequency cutoff was due mainly to recording instruments, and the high-frequency cutoffs to attenuation of the seismic energy of the Earth.—*from* Authors' abstract

00005 **Trettin, H. P.** A Paleozoic-Tertiary fold belt in northernmost Ellesmere Island aligned with the Lomonosov Ridge: Geol. Soc. America Bull., v. 80, no. 1, p. 143-148, illus., 1969.

A south-trending belt of sialic Paleozoic rocks on the northern coast of Ellesmere Island lines up with the Lomonosov Ridge. It was deformed (1) in Middle Ordovician or earlier time, (2) between the Late Silurian and the Middle Pennsylvanian, and (3) in the Tertiary. The Paleozoic movements elevated terrane continuous with the Lomonosov Ridge relative to terrane on the east, but the Tertiary movements did not cause such relative uplift. About 40 km inland, the south-trending orogen terminates against east-trending structures, that conform with the predominant structural grain of northern Ellesmere Island. The zone of structural intersection, marked by Early Devonian (or older) ultrabasic intrusions and a Tertiary graben, was repeatedly a site of crustal extension.—Author's abstract

05745 **Triplehorn, Don M.** Excello Shale, northeastern Oklahoma, clue to locating buried reefs—Discussion [of paper by M. M. Cassidy, 1968]: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 11, pt. 1, p. 2265, 1968.

Triplehorn criticizes Cassidy's failure (ibid., v. 52, no.2, p. 295-312, 1968) to quantify the difference between the two major facies of the Excello Shale, questions the role of the 8-ft thick reef as a barrier to sediment transport, and suggests that the use of kaolinite as an indicator of acid conditions in sedimentary rocks needs to be reevaluated.—VSN

Tschudy, Bernadine B. *See* Drew, Charles M. 05259

Tunell, George. *See* Dickson, Frank W. 05281

05387 **Tweto, Ogden.** Leadville district, Colorado, *in* Ore deposits of the United States, 1933-1967 (Graton-Sales Volume), V. 1: New York, Am. Inst. Mining, Metall. and Petroleum Engineers, p. 681-705, illus., tables, 1968.

The district has produced silver, zinc, lead, and gold; ore deposits are in a sequence of dolomites and quartzites, Cambrian through Mississippian in age and about 500 feet thick, which is extensively intruded by Tertiary porphyry sills, dikes, and plugs. The deposits are principally blanket or manto replacement type but veins occur in the eastern part of the district. Primary ores, principally pyrite, marmatitic sphalerite, and galena, have a crude zonal pattern centered around an intrusive center at Breece Hill. The deposits were oxidized to depths of several thousand feet in Miocene time. The district is a complexly faulted and intruded area at the intersection of two major fault systems; the intensely fractured zone localized igneous intrusion and subsequent mineralization.—*from* Author's abstract

05403 **Tweto, Ogden.** Geologic setting and interrelationships of mineral deposits in the mountain province of Colorado and south-central Wyoming, *in* Ore deposits of the United States, 1933-1967 (Graton-Sales Volume), V. 1: New York, Am. Inst. Mining, Metall. and Petroleum Engineers, p. 551-588, illus., tables, 1968.

In Colorado, the most promising ore deposits are disseminated or stockwork molybdenum deposits associated with Tertiary stocks, combination precious and base-metal veins in Tertiary volcanic rocks, and base-metal replacement deposits and veins in Paleozoic sedimentary rocks. Precambrian veins, while containing metals, are not important. The principal ore deposits of south-central Wyoming are Precambrian iron ores and Tertiary uranium deposits in sedimentary rocks. Two ages of intrusion and ore deposition have been recognized in the Colorado mineral belt, the Laramide and the Oligocene. The major replacement deposits and most of the sulfide veins in Precambrian rocks are Laramide, and the molybdenum, tungsten, and gold telluride veins in Precambrian rocks and precious- and base-metal veins in volcanic rocks are Oligocene.—*from* Author's abstract

05199 **Uchupi, Elazar.** Tortugas terrace, a slip surface?, *in* Geological Survey research 1968, Chap. D: U.S. Geol. Survey Prof. Paper 600-D, p. D231-D234, illus., 1968.

In November 1966, three seismic profiles were recorded on Tortugas Terrace and vicinity, west of Dry Tortugas, Fla., to determine whether the terrace is a structural feature. The study suggests that the terrace is a slump-slip surface, not a fault block.—Author's abstract

05552 **Uchupi, Elazar.** Sedimentary framework of the continental terrace off the east coast of the United States [summ.]: Southeastern Geology, v. 9, no. 4, p. 269-271, illus., 1968.

Data from 20,000 km of continuous seismic profiles supplemented by information from dredgings, coring, drilling and seismic refraction profiles were used to compile a geologic map, isopach maps and reconstruct the evolution of the sedimentary framework of the continental terrace between Nova Scotia and the Florida Keys.—*from* Author's summary

Ullrich, Richard A. *See* Peterson, James A. 05606

00025 **U.S. Geological Survey.** Aeromagnetic map of the Sharon quadrangle and parts of the Ellsworth and Bashbish Falls quadrangles, Connecticut and New York: U.S. Geol. Survey Geophys. Inv. Map GP-640, scale 1:24,000, 1969.

00026 **U.S. Geological Survey.** Aeromagnetic map of the South Canaan quadrangle and parts of the Cornwall and Ashley Falls quadrangles, Litchfield County, Connecticut: U.S. Geol. Survey Geophys. Inv. Map GP-641, scale 1:24,000, 1969.

00027 **U.S. Geological Survey.** Aeromagnetic map of the Broad Brook quadrangle and part of the Manchester quadrangle, Hartford and Tolland Counties, Connecticut: U.S. Geol. Survey Geophys. Inv. Map GP-647, scale 1:24,000, 1969.

00028 **U.S. Geological Survey.** Aeromagnetic map of the Stafford Springs quadrangle and part of the South Coventry quadrangle, Tolland County, Connecticut: U.S. Geol. Survey Geophys. Inv. Map GP-649, scale 1:24,000, 1969.

00029 **U.S. Geological Survey.** Aeromagnetic map of the Westford quadrangle and part of the Spring Hill quadrangle, Tolland and Windham Counties, Connecticut: U.S. Geol. Survey Geophys. Inv. Map GP-650, scale 1:24,000, 1969.

00030 **U.S. Geological Survey.** Aeromagnetic map of the Thompson quadrangle and part of the East Killingly quadrangle, Connecticut and Rhode Island: U.S. Geol. Survey Geophys. Inv. Map GP-653, scale 1:24,000, 1969.

05168 **U.S. Geological Survey.** Geological Survey research 1968, Chap. D: U.S. Geol. Survey Prof. Paper 600-D, p. D1-D269, illus., tables, 1968.

The 48 papers in this concluding volume of research summary for 1968 are grouped into: (1) hydrologic studies—characteristics of the zone of aeration, evaporation, geochemistry of water, geohydrologic dating, analytical studies of streamflow, analysis of ground-water characteristics, glaciology, and sedimentation; (2) geologic studies—structural geology and stratigraphy, paleontology, economic geology, mineralogy and petrology, analytical methods, marine geology, geomorphology,

geochronology, paleomagnetism, and geophysics. Subject and author indexes are included. Pertinent papers are cited separately.—MCM

05770 **Utgaard, John.** A revision of North American genera of ceramoporoid bryozoans (Ectoprocta)—Pt. 1, Anolotichiidae: Jour. Paleontology, v. 42, no. 4, p. 1033–1041, illus., 1968.

The genera *Anolotichia* Ulrich and *Bythotrypa* Ulrich are redefined and, together with the new genus *Crassaluna* and, tentatively, *Scenellopora* Ulrich, are placed in the new family Anolotichiidae. These Ordovician genera are removed from the family Ceramoporidae because of their distinctive wall microstructure and irregular cystlike or boxlike interzooecial spaces ("mesopores" or "cystopores"). Because of the rediscovery of lunaria in post-Paleozoic lichenoporoid cyclostomes and the suggested phylogenetic relationship between the Paleozoic ceramoporoids and fistuliporoids and the lichenoporoids, the order Cystoporata probably should be expanded to include the lichenoporoid cyclostomes.—*from* Author's abstract

Vali, V. *See* Bostrom, R. C. 05438

VanBaalen, Chase. *See* Winters, Kenneth. 00037

VanDenburgh, A. S. *See* Phillips, Kenneth N. 05503

05474 **vanEverdingen, R. O.** Mobility of main iron species in reverse osmosis and the modification of subsurface brines: Canadian Jour. Earth Sci., v. 5, no. 5, p. 1253–1260, tables, 1968.

The relative mobility of ions in cellulose-acetate membranes used for desalination of water by reverse osmosis depends strongly on the size of the hydrated ions. The preferential exchange of ions by compacted clays shows a similar dependence. It is concluded that the same dependence must exist for the mobility of ions in compacted clays and shales acting as semipermeable membranes. Qualitative results of the processes of osmosis and reverse osmosis through these materials thus should be similar to those obtained with the desalination membranes: modification of both chemical composition (ion ratios) and concentration of the solutions involved, and the occurrence of some flow-phenomena that are not in accordance with Darcy's law.—Author's abstract

VanLoenen, R. E. *See* Lee, Donald E. 05195

Veal, Harry K. *See* Garbarini, George S. 05605

05207 **Vey, Eben; Nelson, Raynor D.** Environmental effects on properties of ocean sediments, *in* Civil engineering in the oceans—ASCE Conf., San Francisco, Calif., 1967, Proc.: [New York] Am. Soc. Civil Engineers, p. 531–568, illus., tables, 1968.

The environmental effects of the deep ocean were investigated in direct shear, and vane shear tests on four ocean bottom sediments. Tests were performed in a sea-water environment within pressure chambers to create hydrostatic environmental pressures up to 10,000 psi. The pressure chambers were also refrigerated to provide the required 1 to 3° C environmental temperature. The direct shear tests indicated that there was a decrease in shear strength with increased environmental pressures for fine grained soils at high void ratios. The vane shear tests showed an increase in shear strength with an increase in environmental pressure for the more plastic soil and a decrease in strength with an increase in environmental pressure for the less plastic soil.—Authors' abstract

05301 **Vincenz, S. A.** Resistivity investigations of limestone aquifers in Jamaica: Geophysics, v. 33, no. 6, p. 980–994, illus., table, 1968.

Resistivity depth using several types of electrode configuration were made over water wells in an alluvial interior valley of Jamaica, the Queen of Spain's Valley. Results suggest that the yield is a linear function of the resistivity of the water-bearing strata. It is concluded that resistivity surveys can be of material assistance in a water-supply drilling program in the area. Interpretation by multilayer curve

matching procedures gives more realistic results than analysis by classical two-layer master curves used in conjunction with Hummel's rule; also the Wenner array gives a better resolution of small resistivity contrasts than the operationally more versatile Cooper array. Helmholtz' reciprocity theorem of electrical conduction holds also for rock media.—*from* Author's abstract

Volborth, A. *See* Fabbi, B. P. 05549

05741 **Voorhies, M. R.** Evidence of seasonal growth in Tertiary vertebrate fossils [abs.], *in* Paleobiological aspects of growth and development, a symposium: Paleont. Soc. Mem. 2 (Jour. Paleontology, v. 42, no. 5, supp.), p. 119, 1968.

05764 **Vos, M. A.** (compiler). Hamilton sheet, southern Ontario, drift thickness series: Ontario Dept. Mines Prelim. Map P. 495, scale 1 in. to 1 mi., 1968.

Wagner, Walter R. *See* Lytle, William S. 05727

Wahl, F. Michael. *See* Grim, Ralph E. 05684

05233 **Wahlberg, J. S.; Myers, A. T.** Determination of bromine and iodine by X-ray fluorescence, *in* Geological Survey research 1968, Chap. D: U.S. Geol. Survey Prof. Paper 600-D, p. D214-D216, tables, 1968.

Iodide and (or) bromide are concentrated on an oleic-stearic acid disk, and amounts are then determined by X-ray fluorescence. No interferences have been encountered from several salts tested. The sensitivity is about 1 μg for iodine or 0.1 ppm on a 10-g sample, and about 2 μg for bromine or 0.2 ppm on a 10-g sample.—Authors' abstract

05661 **Wahlstedt, Warren C.; Davis, John C.** FORTRAN IV program for computation and display of principal components: Kansas Geol. Survey Computer Contr. 21, 27 p., illus., tables, 1968.

The process computes principal components of covariance or correlation matrix in geologic materials and plots original data in the form of the first three principal components. Eigenvalues and eigenvectors are extracted from the symmetrical covariance or correlation matrix by a modified Jacobi method; up to 30 variables and 300 observations may be used. The program has been run successfully many times on the GE 625 and IBM/360 Model 65. Two of the problems used as examples are: characterization of Kansas Pleistocene tills by clay minerals, and petrographic variation in sandstones.—ESL

05176 **Wait, Robert L.** Submergence along the Atlantic coast of Georgia, *in* Geological Survey research 1968, Chap. D: U.S. Geol. Survey Prof. Paper 600-D, p. D38-D41, illus., 1968.

Cypress stumps recovered from river terrace material near Brunswick, Ga., may indicate submergence of the Atlantic coastal area during Holocene geologic time. The older material, found at a depth of from 9 to 17 feet below mean sea level, was dated by C-14 at 3,670 ± 300 years (B.P., 1950); the younger, found 1 foot above mean sea level and buried in 3 feet of marsh silt and clay, was dated at 2,780 ± 250 years B.P. Presence of the cypress stumps may indicate that fresh water once discharged from the Turtle River, now a drowned estuary.—Author's abstract

Walker, N. E. *See* Marsden, R. W. 05412

05400 **Wallace, Stewart R.; Muncaster, Neil K.; Jonson, David C.; Mackenzie, W. Bruce; Bookstrom, Arthur A.; Surface, Vaughn E.** Multiple intrusion and mineralization at Climax, Colorado, *in* Ore deposits of the United States, 1933-1967 (Graton-Sales Volume), V. 1: New York, Am. Inst. Mining, Metall. and Petroleum Engineers, p. 605-640, illus., tables, 1968.

In mid-Tertiary time, a wet silicic-alkalic magma penetrated what is now the Tenmile Range of Colorado and formed the Climax stock. Four irruptions are

detectable, each giving rise to a major hydrothermal event; the first three produced mineralization. The ore bodies and related zones of alteration are circular to ring-shaped in plan and arcuate in section; many zones overlap or are juxtaposed. If the parent magma contained 10 percent "water" and the "water" 0.1 g/liter Mb, and the process of extraction was 100 percent efficient, then 10 cu mi of magma would be required to form each ore body. The forceful emplacement of each successive phase of the stock resulted in a slight doming and rotation to the westward. Post-ore normal displacement along Mosquito fault is estimated at 9,000 feet, and the ore is displaced downward in part and in part removed by erosion.—*from* Authors' abstract

05265 **Wanless, R. K.; Stevens, R. D.; Lachance, G. R.; Edmonds, C. M.** Age determinations and geological studies—K-Ar isotopic ages, Rept. 8: Canada Geol. Survey Paper 67-2, pt. A, 141 p., tables, 1968.

One hundred and seventy-six new potassium-argon age determinations carried out on Canadian rocks and minerals are reported. Each age determination is accompanied by a description of the rock and the mineral concentrate used. Brief interpretive comments regarding the geological significance of each age are also provided. The experimental procedures developed for the isotope dilution determination of the potassium concentrations are described as is a method of correcting isotopic abundances for mass spectrometer instrumental discrimination. Two recent geological time-scales are published in tabular form for ready reference. The age determinations are displayed on an accompanying map of Canada.—Authors' abstract

Ward, D. M. *See* Peebles, G. A. 05313

Wardlaw, N. C. *See* McIntosh, R. A. 05473

05599 **Warner, Don L.** Subsurface disposal of liquid industrial wastes by deep-well injection, *in* Subsurface disposal in geologic basins—A study of reservoir strata: Am. Assoc. Petroleum Geologists Mem. 10, p. 11-20, illus., 1968.

Disposal of concentrated, unusable, relatively untreatable liquid wastes is an important problem in water-pollution control. Deep-well injection is one means for disposing of such wastes. The feasibility of deep-well injection depends on site suitability, waste characteristics, economics, and legal considerations. Geologic factors determine site suitability and have an important influence on economics and the suitability of waste for injection. Thus, careful geologic evaluation is a prerequisite for deep-well waste injection. There are at least 110 deep industrial-waste injection wells in the United States. A wide variety of wastes is injected through these wells under extremely varried conditions of flow rate and pressure. Subsurface reservoirs range in age from Pleistocene to Precambrian and, with a few exceptions, are composed of sandstone, limestone, or dolomite.—Author's abstract

05243 **Wasilewski, Peter J.** Magnetization of ocean basalts: Jour. Geomagnetism and Geoelectricity, v. 20, no. 3, p. 129-154, illus., tables, 1968.

Three magnetic classes of ocean basalts are defined on the basis of thermomagnetic and microscopic analysis. Moderate heating of Class I basalts results in an anomalous increase in Curie point, magnetization intensity, the ratio TRM to NRM, and magnetic susceptibility, and of Class II rocks in an anomalous decrease in all magnetic parameters except the Curie point. Class III rocks are stable. Several Class I and II ocean basalts possess the property of self reversal; they contain metastable magnetic minerals and readily transform into stable Class III rocks when heated. Transformation mechanisms are described and characteristics of each class are tabled. *In situ* cores are necessary to discover the distribution of different magnetic classes of ocean basalts in the crust; otherwise, little faith can be placed in interpretation of ocean magnetic anomalies.—*from* Author's abstract

05688 **Waterhouse, J. B.** New species of *Megousia* Muir-Wood and Cooper and allied new genus from the Permian of Australia and North America: Jour. Paleontology, v. 42, no. 5, p. 1171-1185, illus., tables, 1968.

Two new species of *Megousia* are described from Australia, where they occur in mid-Permian strata associated with cold water genera. *Kuvelousia* n.gen. is erected for *Megousia*-like forms in the Arctic Permian of Canada and Spitzbergen, with type species *K. sphiva* n.sp. from the Arctic Archipelago of Canada. The genus typifies the "Svalbardian" Stage of Stepanov (1957) (Ufimian of the Russian Platform), but is not found in the Assistance Formation of Arctic Canada, here considered slightly older than the Svalbardian. *K. leptosa* n.sp., from the mid-Permian of Oregon, is referred to this genus. [These genera are included in a new subfamily of linoproductid brachiopods, Anidanthinae.]—*from* Author's abstract

05723 **Weaver, Charles E.** Geochemical study of a reef complex: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 11, pt. 1, p. 2153–2169, illus., 1968.

In Alberta, Canada, the Leduc and Duhamel reefs of the Upper Devonian Woodbend Group are surrounded by calcareous shale and argillaceous limestone of the Ireton Formation and the underlying Duvernay Formation. The variable content of strontium, barium, and calcite in samples from interreef sediments reflects the presence of adjacent reefs. Strontium and calcium contents increase and barium content decreases in the vicinity of known reefs. Strontium content was found to be the best reef indicator.—BHK

05247 **Webb, Robert W.** Memorial to William John Miller (1880–1965): Geol. Soc. America Proc. 1966, p. 303–307, portrait, 1968

05646 **Webb, Robert W.** Copper in rock-tubes—A desert mystery: California Div. Mines and Geology Mineral Inf. Service, v. 21, no. 11, p. 159–162, illus., 1968.

Fulgurites recently found on the hillslope of a mining claim in Riverside County, Calif., are in undecomposed quartz diorite of the Chuckwalla Complex. A number of excavations are reported to have been in a "root" system; three still in place are as large as 2 inches in diameter and 15 inches in length. Unfused margins of the tubes have highly fluorescent feldspar crystals, reflecting stress. Vesicles oriented crudely attest to the mobility of the glass, and obsidian from the tubes has flowed out over pebbles in adjacent alluvium. Of particular interest is metallic copper that fills the vesicles indiscriminantly. There are few signs of copper in the massive and uniform country rock, but some copper in wire form, on the ground for some time, relates it to stolen power lines discarded by thieves. It is suggested that this copper was the attractor for repeated strikes of lightning.—GDC

05212 **Webb, S. David; Tessman, Norm.** A Pliocene vertebrate fauna from low elevation in Manatee County, Florida: Am. Jour. Sci., v. 266, no. 9, p. 777–811, illus., tables, 1968.

An unequivocally Hemphillian fauna of the Bone Valley type is described from the Manatee County dam site. Three habitats (savannah, stream, and estuary) are present. Sharks are the most abundant; these today range into estuarine and fresh-water streams. If the land has been stable tectonically since at least Miocene, then the sea dropped as low as the level of the Manatee site, 6 feet above present sea level. Evidence of eustatic fluctuations of over 90 feet during Hemphillian time is present. A horse species and a tortoise are reported from the eastern U.S. for the first time, and other genera and species are discussed and described.—*from* Authors' abstract

05476 **Weber, J. R.; Goodacre, A. K.** An analysis of the crust-mantle boundary in Hudson Bay from gravity and seismic observations: Canadian Jour. Earth Sci., v. 5, no. 5, p. 1297–1303, illus., 1968.

A study of the results of the gravity and seismic surveys in Hudson Bay in 1965 has shown that the gravitational effect of a two-layer model based on the seismically determined depths has no correlation with the observed gravity anomalies. On the profile from Churchill to Povungnituk the gravity and seismic observations can be reconciled by postulating lateral variations of the acoustic compressional wave velocity within the crust. A crustal model has been calculated—using the same time-terms and the same mean crustal velocity—whose gravitational effect fits the observed gravity. The velocity varies from 6.15 to 6.56 kmps and the postulated

depths are almost entirely within the confidence limits of the original model.—*from* Authors' abstract

05324 **Weeks, J. P.** Ore reserve estimation and grade control at the Bralorne mine, *in* Ore reserve estimation and grade control—Canadian Centennial Conf., Quebec, 1967: Canadian Inst. Mining and Metallurgy Spec. Vol. 9, p. 233–238, illus., tables, 1968.

A brief outline of the geology and mining methods at the Bralorne gold mine [British Columbia] precedes a description of the sampling procedures, the method of calculating ore reserves and a discussion of "swell." The second part of the paper describes the grade control organization and routine established to ensure that production continues at the optimum grade. Examples showing the actual production from certain stopes compared with the estimated diluted reserve tonnage and grade confirm the accuracy of the ore reserve valuation and evidence is introduced to show that, although the reliability of any individual car sample is small, results, when grouped together in sufficient numbers, are sufficiently consistent to give a satisfactorily accurate record of the grade drawn from each working place.—Author's abstract

05432 **Weeks, Lewis G.** The ocean's resources: Offshore, v. 28, no. 7, p. 39–48, 87–88, illus., tables, 1968.

The current status of the offshore petroleum industry, potential world-wide offshore petroleum resources, and gas reserves are considered, and examples of offshore successes are given. About 75 countries are active in searching for petroleum offshore; among the areas described are Cook Inlet, Alaska, Santa Barbara Channel, Calif., the Gulf Coast, and the Arctic Islands of Canada. The only offshore production of sulfur at present is from Grande Isle salt dome off the Louisiana coast. Other mineral resources discussed include those in sea water. Low temperature source mineral deposits make up most of those offshore. Sections on marine biological resources and ship building conclude the report.—ESL

05219 **Weeks, Ross M.** Ore reserve estimation and grade control at the Quemont mine, *in* Ore reserve estimation and grade control—Canadian Centennial Conf., Quebec, 1967: Canadian Inst. Mining and Metallurgy Spec. Vol. 9, p. 123–129, illus., table, 1968.

Accurate estimation of Quemont's ore reserves [Quebec] is based on the principle that the sphere of influence of each unit of grade information is representative of the tonnage involved. When properly applied to the Quemont orebodies, the cross-section method, the interpolation method and the straight-line method permit accurate ore reserve estimates. The inclusion in ore outlines of waste dikes and erratic high-grade patches must be carefully weighted, in each ore zone, on a set of standards based on previous extraction experience. Effective grade control requires: complete geological and grade information for all ore zones; accurate long-range estimates of the tonnage and grade to be obtained from each ore zone; the selection of proper mining methods and rate of extraction in each zone; and daily control over extraction grade, based upon sound geological interpretation of the ore structure in each working place.—Author's abstract

05765 **Weertman, J.** Diffusion law for the dispersion of hard particles in an ice matrix that undergoes simple shear deformation: U.S. Army Materiel Command Cold Regions Research and Eng. Lab. Research Rept. 252, 6 p., illus., table, 1968.

A diffusion equation is obtained that describes the mechanical dispersion of a dilute mixture of solid particles within an ice matrix that is undergoing deformation. It is shown that within the limits of time intervals and strain rates appropriate to the movement of glacier and ice sheets the dispersal distance usually is no larger than a distance about one order of magnitude greater than the size of the particles themselves.—Author's abstract

Weinberg, Edgar L. *See* Brown, W. Horatio. 05423

Weir, A. H. *See* Roberson, H. E. 05569

05189 **Weir, Gordon W.; Peck, John H.** Lithofacies of Upper Ordovician rocks exposed between Maysville and Stanford, Kentucky, *in* Geological Survey research 1968, Chap. D: U.S. Geol. Survey Prof. Paper 600-D, p. D162-D168, illus., table, 1968.

Upper Ordovician strata overlying the Garrard Siltstone and the Kope Formation in east-central Kentucky are divided into nine lithofacies based on differences in composition, texture, bedding, and fossil content. Strata in southeast-central Kentucky are dominantly unfossiliferous dolomitic mudstone lithofacies which mostly pinch out near Owingsville, east-central Kentucky. Equivalent strata in northeast-central Kentucky are made up chiefly of very fossiliferous limestone and mudstone lithofacies. The lithofacies were deposited on a shelf in an inland sea that toward the south was generally shallower and closer to a source of terrigenous material.—Authors' abstract

Weiss, A. *See* O'Brian, D. T. 05218

05492 **Weiss, Charles M.; Okun, Daniel A.** Water quality technology—Present capabilities and future prospects [with French and Spanish summ.], *in* Water for peace—Internat. Conf., Washington, D.C., 1967—V. 4, Water supply technology: Washington, D.C., U.S. Govt. Printing Office, p.195-211, tables, 1968.

Surface tension and solvent action are the principal properties of water that combine to create continuing conditions of change in quality. The practicality of keeping pollutants out of river systems must be assessed against the cost of providing treatment processes. Uncontrolled erosion in the United States has produced nearly four billion tons of sediment annually, thus contributing to pollution. Agriculture contributes to pollution through: use of fertilizers, particularly nitrogen and phosphorus compounds, which affect streams; increased plant productivity which may harm normal water uses; and larger animal populations whose waste affects ground water also. Pesticides, atomic wastes, municipal and industrial waste waters, and thermal pollution contribute to the problems also. Management of storage for water quality and a realistic evaluation of conditions is needed for the future.—MCM

Wells, Terry L. *See* MacTavish, John N. 05773

05327 **Welwood, R. J. R.** Ore reserve estimation and grade control at Brunswick Mining and Smelting, *in* Ore reserve estimation and grade control—Canadian Centennial Conf., Quebec, 1967: Canadian Inst. Mining and Metallurgy Spec. Vol. 9, p. 168-171, illus., 1968.

The Brunswick orebodies consist of massive lead, zinc, and copper sulfides, with varying amounts of pyrite. Proven and probable ore reserves are calculated annually, determined by horizontal diamond drill holes. Grade control is also based on core assay results.—*from* Author's abstract

05759 **Wendel, Clarence A.** The discovery-development barrier in the mineral industry, *in* CENTO symposium on development and utilization of mineral resources, Karachi, Pakistan, 1968: Ankara, Turkey, Central Treaty Organization, p. 67-80, illus., tables, 1968.

Mineral deposits are discovered in six ways: original discoveries of virgin deposits, rediscovery of previously known deposits, reopening of old mines, reopening of modern mines, recognition of large low-grade deposits, and geological discoveries. Prospectors are classified as career (sourdough), casual, and professional, and government, corporation, and consulting geologists. Only large mining companies are normally in a position to furnish or acquire resources needed to cross the discovery-development barrier, both financially and technically; well-trained field geologists are essential. Government can be of assistance through its geologic agencies in providing accurate geologic maps and interpretations needed to outline mineralization trends, and contributing specialized scientific data to narrow required field of investigations of the companies.—MCM

Werner, R. F. *See* Marsden, R. W. 05412

05589 **Whetstone, G. W.; Schloemer, R. W.** National environmental data-collection systems for water resources development [with French and Spanish summ.], *in* Water for peace—Internat. Conf., Washington, D.C., 1967—V. 4, Water supply technology: Washington, D.C., U.S. Govt. Printing Office, p.753–761, illus., 1968.

This brief summary of systems used in the collection and processing of water resources data touches upon only a few of the advances made in recent years in this field. The organization and operation of new environmental data systems should take into account the users' requirements for water-resources data and develop the collection system best suited to provide the data needed. Emphasis should be placed initially on development of regional or basin-flood and drought-flows information concurrently with development of a continuing hydrologic network. Provision should be made for orderly publication of results of the data-collection program. Utilization of computer programs for processing and analysis should be developed in the early planning stages of the data-collection program.—*from* Authors' summary

White, Donald E. *See* Clayton, R. N. 05269

05655 **White, G. W.** Pleistocene deposits of the north-west Allegheny Plateau, U.S.A. [abs.]: Geol. Soc. London Proc., no. 1648, p. 67–68; discussion, p. 68–70, 1968.

White, W. S. *See* Ensign, C. O., Jr. 05409

05386 **White, Walter S.** The native-copper deposits of northern Michigan, *in* Ore deposits of the United States, 1933–1967 (Graton-Sales Volume), V. 1: New York, Am. Inst. Mining, Metall. and Petroleum Engineers, p. 303–325, illus., table, 1968.

The copper occurs primarily in open-space fillings and replacements in amygdaloidal flow tops and conglomerate beds of the Portage Lake Lava Series, of Middle Keweenawan age. A zonal pattern of secondary minerals transects bedding and suggests regional metamorphism mainly to the grade of the prehnite-pumpellyite graywacke facies of Coombs. Most of the major copper deposits are near the upper limit of abundant quartz in this zonal pattern. Copper distribution is controlled partly by primary permeability of the rocks and partly by later tectonic fracturing. The copper-bearing solutions that formed the deposits were ascending, possibly from a large concealed intrusive or from the porous tops of lava flows when they were compacted at great depth in the Lake Superior syncline.—*from* Author's abstract

Whitham, Kenneth. *See* Smith, W. E. T. 05460

05455 **Wickens, A. J.; Pec, K.** A crust-mantle profile from Mould Bay, Canada, to Tucson, Arizona: Seismol. Soc. America Bull., v. 58, no. 6, p. 1821–1831, illus., table, 1968.

Love-wave phase velocities were determined for five adjacent segments of a 5,000 km great circle path from Mould Bay, Canada, to Tucson, Ariz. Mean-phase velocity curves were obtained from curves based on reciprocal data, thus minimizing the detrimental effects of nonparallel layering. By careful selection and precise treatment of the data over relatively short distances (800 km), detail hitherto suppressed has been retained. Finally, by using reciprocal seismograms, the effect of sloping interfaces was observed. The crustal and upper mantle models obtained indicate significant differences in structure between different provinces of the Precambrian Shield.—Authors' abstract

05861 **Wickman, Frans E.** Repose period patterns of volcanoes—[Pt.] 5, General discussion and a tentative stochastic model: Arkiv Mineralogi och Geologi, v. 4, pt. 5 (no. 11), p. 351–367, illus., tables, 1968.

The patterns of volcanic repose periods studied in previous papers of this series form the basis of the present paper. The volcanoes are first regarded as simple Poisson volcanoes (eruption rates constant in time); in this model no natural limit

exists between real outbreaks and persistent activity, and very small rates give long reposes. Some consequences of this fact are discussed. Two models with several states are studied: a two-chamber model with a primary magma chamber having the eruption rate λ, a secondary chamber refilled from the primary one having an eruption rate ν, and "death rate" μ; and a one-chamber model with a conduit. The survival member function and eruption rate are calculated for these two models and found to be identical. Numerical calculations are made for Kilauea, Fuji and Asama. Volcanoes having a "loading time" are discussed.—*from* Author's abstract

05445 **Widmer, Kemble.** Geology as a guide to regional estimates of the water resource: New Jersey Geol. Survey Geol. Rept. Ser., no. 8, 15 p., illus., table, 1968.

Geologic conditions within New Jersey establish five ground-water provinces with widely divergent potentials and problems. Three-fifths of the State is a coastal plain where ground water is abundant and easily utilized. Estimates of ground-water potential should be based upon outcropping of a formation, usual geologic and hydrologic factors, and the area within which wells may be constructed to utilize sand formations. The northern two-fifths of the State is underlain by rock formations in three ground-water provinces where fissure water conditions prevail. The glaciated part of northeastern New Jersey forms a fifth ground water province; presence or absence and character of Pleistocene cover changes the ground-water potential of every formation. Examination of large numbers of well records from any formation indicates safe sustained yield in gpd/sq mi, from which residential and industrial expansion can be considered.—*from* Author's abstract

05298 **Wilkinson, J. F. G.** Analcimes from some potassic igneous rocks and aspects of analcime-rich igneous assemblages: Contr. Mineralogy and Petrology, v. 18, no. 3, p. 252–269, illus., tables, 1968.

The mineralogy and chemistry of some analcime-rich igneous rocks—analcimites from the potassic Highwood province, Montana, and an analcime tinguaite from the Dunedin volcanic complex, New Zealand—have been investigated to obtain some indification of the $K \rightarrow Na$ substitution in natural analcimes. The analcimes have potash-poor compositions, the K_2O revealed by the rock analyses being represented in the mode mainly by the Or-rich feldspar (hyalophane or sanidine). These data and the evidence afforded by other analcime compositions confirm earlier conclusions based on experimental studies (Peters, Luth, and Tuttle, 1960), namely that analcime solid solutions may contain up to approximately 2 percent K_2O. Some aspects of analcime-rich igneous assemblages are also discussed.—Author's abstract

05335 **Willard, Robert J.** Scanning electron microscope: Geotimes, v. 13, no. 7, p. 16–18, illus., 1968.

One area of research in which the scanning electron microscope can play a useful role is in microtopographic study of rock and mineral fracture surfaces. Photographs show the instrument's superb depth of focus, resolution, and magnification. The minute features revealed may provide clues to fracture processes on larger scales. Part of the thermally spalled surface on a small block of Sioux Quartzite from southwestern Minnesota was scanned as an example.—GDC

05562 **Willis, Joe C.** A lag-deviation method for analyzing channel bed forms: Water Resources Research, v. 4, no. 6, p. 1329–1334, illus., table, 1968.

A simple method for analyzing alluvial channel bed forms for length and time scales can be applied to records of bed elevation with either distance along the channel or time as moving bed forms pass a channel section. The difficulty of obtaining distance records of bed-form elevation in the field is lessened by the use of simultaneous time records from two closely spaced points along the channel. Analysis of these dual records provides the dune period and propagation speed from which the dune length may be derived and permits an estimate of the 'dune load,' the average contribution of the moving bed forms to the bed material transport rate.—Author's abstract

05579 **Wilmoth, Benton M.** Hydrogeology of Kanawha Valley: West Virginia Acad. Sci. Proc. 1968, v. 40, p. 236–245, illus., table, 1968.

The Kanawha River in West Virginia is entrenched in rocks of Pennsylvanian age, and valley-fill alluvium of Pleistocene and Recent ages overlies the bedrock. Massive sandstone and conglomerate beds of the Pottsville and Allegheny Groups along the eastern half of the valley are good sources of ground water and have been developed for moderate industrial and municipal supplies. The predominantly shale aquifers of the Conemaugh and Monongahela Groups, along the western half of the valley, yield only enough water for small commercial and farm supplies. Sand and gravel alluvium, especially along the wide flood plains of the western half of the valley, constitute a good aquifer for moderate industrial and municipal supplies.—*from* Author's abstract

05535 **Wilson, Charles W., Jr.** Mineral resources summary of the Woodbury quadrangle, Tennessee: Nashville, Tenn., Tennessee Div. Geology, 12 p., tables, 1968.

Mined mineral resources in the Woodbury quadrangle are limestone from the Bigby-Cannon, Carters and St. Louis Limestones, and gravel from flood plains and beds of East Fork of Stones River and its major tributaries. Five test wells drilled for oil and gas were dry. One zinc occurrence has been drilled and prospected, and large quantities of chert occur in the Fort Payne Formation. This text accompanies Tennessee Div. Geology Geol. Map GM 319-SE by C. W. Wilson, Jr. and R. H. Barnes (cited separately).—MCM

05537 **Wilson, Charles W., Jr.** Mineral resources summary of the Sligo Bridge quadrangle, Tennessee: Nashville, Tenn., Tennessee Div. Geology, 12 p., tables, 1968.

Mined mineral resources in the Sligo Bridge quadrangle are limestone, gravel, and Chattanooga Shale, the latter on an experimental basis to determine the feasibility of extracting its uranium content. Six abandoned limestone quarries are in the St. Louis Limestone (best for most uses), and Leipers, Catheys, and Warsaw Formations. Chert gravel for road surfacing has been dug from bars and the bed of Sink Creek. Alluvial deposits of sand are relatively extensive, but high clay and silt content limits usefulness. Tabulated data indicate uranium content of the Chattanooga Shale averages between 0.006 and 0.008 percent; difficulty of extraction presents special mining and metallurgical problems. This text accompanies Tennessee Div. Geology Geol. Map GM 327-NW by C. W. Wilson, Jr. and R. H. Barnes (cited separately).—MCM

Wilson, Charles W., Jr. *See* Taylor, Landon C. 05538

05541 **Wilson, Charles W., Jr.; Barnes, Robert H.** Geologic map of the Woodbury quadrangle, Tennessee: Tennessee Div. Geology Geol. Map GM 319-SE, scale 1:24,000, separate text, 1968.

The accompanying text, "Mineral resources summary of the Woodbury quadrangle, Tennessee," by C. W. Wilson, Jr. is cited separately.—MCM

05542 **Wilson, Charles W., Jr.** Geologic map of the Smithville quadrangle, Tennessee: Tennessee Div. Geology Geol. Map GM 323-NE, scale 1:24,000, separate text, 1968.

The accompanying text, "Mineral resources summary of the Smithville quadrangle, Tennessee," describes briefly the chert gravel dug from the bed and bars of Sink Creek. Limestone and chert are potential resources, and considerable prospecting has been done to test oil and uranium content of the Chattanooga Shale. Tabulated data indicate uranium content is very low and ore is difficult to extract; oil content ranges from 0.5 to 14.9 gallons per ton.—MCM

05543 **Wilson, Charles W., Jr.** Geologic map of the Dibrell quadrangle, Tennessee: Tennessee Div. Geology Geol. Map GM 323-SE, scale 1:24,000, separate text, 1968.

The text, "Mineral resources summary of the Dibrell quadrangle, Tennessee," describes briefly the limestone in the Warsaw Formation, and chert gravel from flood plains and gravel bars in Mountain Creek and Long Hollow Branch.—MCM

05544 **Wilson, Charles W., Jr.; Barnes, Robert H.** Geologic map of the Sligo Bridge quadrangle, Tennessee: Tennessee Div. Geology Geol. Map GM 327-NW, scale 1:24,000, separate text, 1968.

The accompanying text, "Mineral resources summary of the Sligo Bridge quadrangle, Tennessee," by C. W. Wilson, Jr. is cited separately.—MCM

05545 **Wilson, Charles W., Jr.** Geologic map of the Livingston quadrangle, Tennessee: Tennessee Div. Geology Geol. Map GM 330 -NE, scale 1:24,000, separate text, 1968.

The accompanying text, "Mineral resources summary of the Livingston quadrangle, Tennessee," by L. C. Taylor and C. W. Wilson, Jr. is cited separately.—MCM

Wilson, James E. *See* McCann, Thomas P. 05601

05559 **Wilson, L. G.; deCook, K. J.** Field observations on changes in the subsurface water regime during influent seepage in the Santa Cruz River: Water Resources Research, v. 4, no. 6, p. 1219–1234, illus., 1968.

Field studies were conducted during the winter 1965–1966 at an instrumented research site near Tucson, Ariz., to characterize changes in the subsurface water regime of the stratified sediments at the site during influent seepage in the Santa Cruz River. At the peak of recharge from the principal runoff event of the winter, observation well data accounted for 33 percent of the observed total change in the subsurface water content. The remaining 67 percent, observed by means of moisture logs in access tubes, was contained in two near-saturated mounds in the intermediate vadose zone. Slow drainage of water from these mounds into the semiconfined phreatic zone apparently reduced the rates of recession of observation well hydrographs. Water content changes in the intermediate vadose zone and related long-term drainage should be accounted for during water balance studies and aquifer testing in the Tucson Basin.—Authors' abstract

05270 **Wilson, L. R.** Diatom succession in a Laverne (Pliocene) deposit of Oklahoma: Oklahoma Acad. Sci. Proc. 1966, v. 47, p. 210–213, 1968.

The diatoms from the Laverne zone of the Ogallala Formation in Beaver County are discussed. The total exposure is about 23 feet thick, of which one zone, 15 feet thick, contains diatoms. A lower Pliocene age for the zone is based upon associated vertebrates and plant megafossils. Thirty-seven species are known, and probably another fifty species could be added with *Cymbella ehrenbergii* comprising about 85 percent of the specimens. The ecology of the extant species in the deposits suggests that the lake water was generally cool and clear. The source of silica for the diatoms probably came from the volcanic deposits that are extensive in the region.—HRC

05371 **Wilson, N. E.** Shear mechanism in fibrous peat—Sess. 3, Free discussion on Shear strength of soil other than clay, *in* Geotechnical conference on shear strength properties of natural soils and rocks, Oslo, 1967, Proc., V. 2: Oslo, Norwegian Geotechnical Inst., p. 215–216, illus., 1968.

Current research in Canada confirms observations that results of vane tests for determining shear strength of fibrous peat may not be reliable due to internal friction between the fibers and their arrangement. In this research it was noted that the maximum torque occurred after a rotation in excess of 180° , and that voids were formed behind the vane blades. As the vane rotated, interlocking fibers tightened as a rope acquires tensile strength due to weaving. In viscometer tests on samples of amorphous-granular peat with fine fibers and a water content of 400 percent, the peat behaved as a thixotropic material; the torque value at a given shearing rate decreased with time, more rapidly at a faster rate.—GDC

05630 **Winder, C. Gordon.** Carbonate diagenesis by burrowing organisms, *in* Internat. Geol. Cong., 23d, Prague, 1968, Proc., Sec. 8, Genesis and classification of sedimentary rocks: Prague, Academia, p. 173–183, illus., 1968.

Ancient carbonates could be sufficiently modified before consolidation by burrowing organisms that the original fabric created by physical processes can be overshadowed by the fabric developed by the organisms. Activities of burrowers can be recognized by pellets, disrupted and discontinuous laminae, patches of micrite with a clear calcite core, barriers of valves between micrite and sparite, distinct and indistinct mottlings, high incidence of lithologic specimens consisting of combined biosparite and biomicrite, and hard parts of organisms which are known to have burrowed.—Author's conclusions

00037 **Winters, Kenneth; Parker, P. L.; VanBaalen, Chase.** Hydrocarbons of blue-green algae—Geochemical significance: Science, v. 163, no. 3866, p. 467–468, tables, 1969.

The hydrocarbon compositions of 11 species of blue-green algae are simple and qualitatively similar. Three marine coccoids contain only monoenoic and dienoic C_{19} hydrocarbons. Hydrocarbons of the remaining eight species are C_{15} to C_{18}. Hydrocarbons of higher molecular weight (C_{20} or more) were not detected. Blue-green algae do not appear to be the source material for the long-chain (greater than 20 carbons) hydrocarbons found in ancient sediments.—Authors' abstract

00007 **Woldenberg, Michael J.** Spatial order in fluvial systems—Horton's laws derived from mixed hexagonal hierarchies of drainage basin areas: Geol. Soc. America Bull., v. 80, no. 1, p. 97–112, illus., tables, 1969.

The number of stream–basin areas (Strahler stream segments) is predicted from an hexagonal model. The number of orders and number of basins per order, balance opposing tendencies for minimum overland work for streams in small basins and maximum work savings in large channels. Entropy of the system approaches the maximum possible. The model agrees with empirical data where land surface is uniform with regard to structure and lithology. Approximate geometric progression of basin areas with order creates geometric progression of other parameters leading to the power function, allometric growth. An identical model predicts numbers of market areas per order in a system of cities, and structure of bile ducts in a bovine liver.—*from* Author's abstract

05391 **Wood, Hiram B.** Geology and exploitation of uranium deposits in the Lisbon Valley area, Utah, *in* Ore deposits of the United ' tates, 1933–1967 (Graton–Sales Volume), V. 1: New York, Am. Inst. Mining, Metall. and Petroleum Engineers, p. 770–789, illus., table, 1968.

The uranium deposits are in an arcuate belt on the southwest flank of the Lisbon Valley anticline. The ore bodies are tabular, average six feet thick, may be amoeba-shaped masses, concordant to the bedding, and are in the lowest, sandstone unit in the Moss Back Member of the Chinle Sandstone. The host rock is predominantly a fluviatile, calcareous, fine-grained to conglomeratic sandstone. Uraninite, the principal ore mineral, fills the pores in the sandstone and partly replaces sand grains and fossil wood fragments. The uranium, probably derived from the lower Chinle Formation by diagenetic processes, was transported in connate waters and deposited under reducing conditions.—*from* Author's abstract

05246 **Woodring, W. P.** Memorial to Marcus Isaac Goldman (1881–1965): Geol. Soc. America Proc. 1966, p. 229–232, portrait, 1968.

05637 **Woodring, W. P.** The term Holocene: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 11, pt. 1, p. 2267, 1968.

Woodring registers dissent against the adoption, by the Geologic Names Committee of the U.S. Geological Survey, of the term *Holocene* to replace the term *Recent*.—VSN

Woods, R. D. *See* Roberson, H. E. 05569

05628 **Wray, John L.** Late Paleozoic phylloid algal limestones in the United States, *in* Internat. Geol. Cong., 23d, Prague, 1968, Proc., Sec. 8, Genesis and classification of sedimentary rocks: Prague, Academia, p. 113–119, illus., 1968.

Leaflike or phylloid calcareous algae are abundant constituents in Upper Carboniferous and lower Permian marine limestones throughout central and western United States. The genera *Archaeolithophyllum, Anchicodium, Eugonophyllum,* and *Ivanovia* are the most common late Paleozoic phylloid algae. In addition to the important volumetric contribution of phylloid algae to the formation of late Paleozoic limestones, these algae probably exerted significant sedimentological controls. Crustose forms were capable of providing both a self-supporting skeletal framework and a sediment-binding function at the time of deposition. Phylloid algae were also important in the development of initially porous biohermal and biostromal facies, some of which are petroleum reservoirs.—*from* Author's abstract

Wright, G. M. *See* Stockwell, C. H. 05653

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Wyllie, P. J. *See* Koster van Groos, A. F. 05215

00024 **Wyoming Governor's Conf. on Uranium.** Report on Wyoming Governor's Conference on uranium, Casper, Wyo., 1968: Mines Mag., v. 59, no. 1, p. 4–33, 1969.

Reports by several authors on the discovery, exploration, and geology of Wyoming uranium deposits and national requirements for uranium are included. Papers by R. V. Bailey and E. W. Grutt, Jr., are cited separately.—RPF

Wyss, Max. *See* Smith, Stewart W. 05454

Yates, J. C. *See* Reynolds, S. E. 05592

05201 **Yates, Robert G.; Engels, Joan C.** Potassium-argon ages of some igneous rocks in northern Stevens County, Washington, *in* Geological Survey research 1968, Chap. D: U.S. Geol. Survey Prof. Paper 600-D, p. D242–D247, illus., table, 1968.

Isotopic dating of igneous rocks from northern Stevens County, Wash., leads to the conclusion that there were two separate and distinct post-Jurassic igneous events—one about 100 m.y. ago in Cretaceous time, and the other about 50 m.y. ago in middle Eocene time. The rocks recording the Cretaceous event are plutonic; those recording the Eocene event are both plutonic and volcanic. The Cretaceous rocks are calc-alkaline and include the Spirit pluton and Kaniksu batholith. The Eocene rocks are alkaline and include satellitic dikes of the Coryell batholith as well as hypabyssal dikes and sills of shonkinite and lamprophyre.—Authors' abstract

05273 **Young, Grant M.** Precambrian geology of the region north of Manitoulin Island, *in* The geology of Manitoulin Island—Michigan Basin Geol. Soc., Ann. Field Excursion, 1968: [Lansing, Mich., Michigan Geol. Survey] p. 18–24, illus., 1968.

The area, known as the Espanola-Sudbury area, is underlain by metamorphosed sedimentary rocks of Huronian age. The section, considered Lower Aphebian, is composed of the Elliot Group at the base, overlain by the Hough Group, Quirke Group, and the Cobalt Group at the top, the total thickness being over 28,000 feet. All were originally clastic sedimentary rocks and well-preserved sedimentary structures are common. The Huronian rocks are truncated at the east by the Grenville front and are otherwise considered part of the Penokean fold belt, in which at least three intervals of tectonism and also thermal metamorphism are recognized. The folded metamorphic rocks are truncated by diabase dikes of Keweenawan age.—HRC

05421 **Young, Robert S.** Mineral exploration and development in Maine, *in* Ore deposits of the United States, 1933–1967 (Graton–Sales Volume), V. 1: New York, Am. Inst. Mining, Metall. and Petroleum Engineers, p. 125–139, illus., table, 1968.

Most of the exploration activity in Maine has been concentrated in the northern and southern volcanic belts. Notable examples of recent activity, directed to sulfide minerals, include: (1) Knox County nickel–copper–bearing ultramafic rocks, (2) Harborside (Cape Rosier) copper–zinc deposit, (3) Second Pond (Black Hawk) zinc–copper–lead–silver deposit, (4) Big Hill–Barrett lead–zinc–silver–copper–gold zones, (5) Parmachenee copper–zinc belt, (6) Moxie Lake nickeliferous peridotite, and (7) Attean quartz–monzonite molybdenum–copper occurrences. The Second Pond and Harborside prospects appear to be close to production. Investigation for nonmetallics is directed toward limestone, asbestos, diatomaceous earth, and spodumene–bearing pegmatites.—*from* Author's abstract

Zangerl, Rainer. *See* Bardack, David. 05254

Zimmert, Paul W. *See* Dutton, Carl E. 05413

05670 **Zingula, R. P.** A new breakthrough in sample washing: Jour. Paleontology, v. 42, no. 4, p. 1092, 1968.

The detergent Quaternary "O" is effective in disaggregating hard shales and argillaceous sandstones and limestones that do not respond readily to other commonly used techniques. A 20 percent solution is added to the sample in boiling water and boiling is continued for about an hour. The solution is weakly acid and extended boiling increases the chance of solution damage to calcareous tests.—RCD

05204 **Zohdy, Adel A. R.** The effect of current leakage and electrode spacing errors on resistivity measurements, *in* Geological Survey research 1968, Chap. D: U.S. Geol. Survey Prof. Paper 600–D, p. D258–D264, illus., 1968.

Distortion of vertical electrical sounding curves often results from errors in measurement of apparent resistivity; the most important error source is leakage of current from damaged insulation on cables. Leakage effect on resistivity curves can be mathematically analyzed in regard to dependence of that effect on the unreeling procedure of cables in the field. If leakage does not take place through current reels, it is best to maintain the reels at the array center. When leakage takes place near the array center it is possible to measure negative apparent resistivities. A formula is derived for computing errors arising from inaccuracies in measurement of electrode spacing distances. Calculations indicate that errors in current electrode spacings result in larger errors in apparent resistivity than corresponding errors in potential electrode spacings.—*from* Author's abstract

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